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# Organizing for An Increased Output

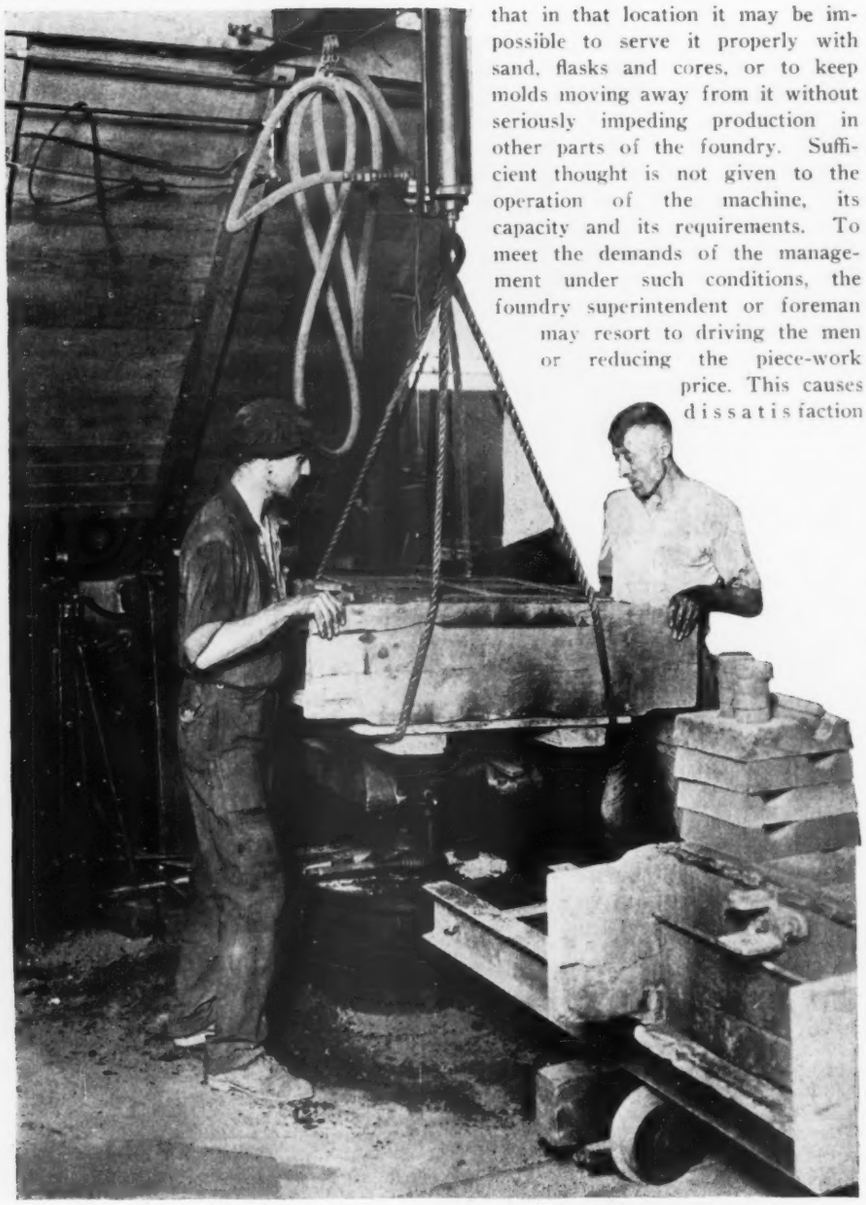
## If Molding Machines Are Used Simple but Efficient Auxiliary Equipment Insures Maximum Production by Facilitating Rapid Handling of Molds— Machines Must Have Intelligent Attention

BY K. V. WHEELER

ONE of the big problems of the foundryman is to eliminate as far as possible the personal equation in making castings. Relative scarcity of skilled molders and indeed all classes of labor have made it imperative for executives to devise means to meet the increased demand for castings. The development of the modern molding machine has been a most important step in this direction.

The objection of some molders to the use of machines is fast passing, but while progressive foundrymen have awakened to the importance of standard-

SAND IS CONVEYED TO THE HOPPER BY GRAB BUCKET. AS QUICKLY AS THE MOLDING MACHINE HAS FINISHED ITS WORK THE DRAG IS SWUNG OUT ON TO A RACK, THE RACK IN PUSHED FORWARD IN LINE WITH THE COPE MACHINE, AND THEN TO THE POURING LADLE



MACHINE-MOLDING UNIT PRODUCING 25 MOLDS PER HOUR

ized practice many of them still are prejudiced against the use of machines.

This may be attributed to many causes. An aggressive salesman may misrepresent his machine. He may cite instances in which one or more men have produced a record number of molds, and he will lead the prospective buyer to assume that this should be the average production. In his eagerness to make a sale, he may fail to consider limited shop equipment, the particular job for which the machine is intended, and the men available to operate it, factors which are all of importance.

The machine is purchased with the expectation that it will immediately show increased production, and lower costs. It sometimes is placed on the floor where the pattern has been worked, or it may be put in the middle of the shop, where men operating it will have plenty of room, regardless of the fact that in that location it may be impossible to serve it properly with sand, flasks and cores, or to keep molds moving away from it without seriously impeding production in other parts of the foundry. Sufficient thought is not given to the operation of the machine, its capacity and its requirements. To meet the demands of the management under such conditions, the foundry superintendent or foreman may resort to driving the men or reducing the piece-work price. This causes dissatisfaction among the workers, and strengthens prejudice against the machine.

The foundrymen who installed the machine are not always to blame for subsequent difficulties. Sometimes the purchasing department will not co-operate to the extent of buying necessary additional equipment.

The foundry where a machine is installed may be operated on the old "hit or miss" plan. It may not have special machinery, and no need therefore for a special maintenance force. After the machine is installed it suffers for lack of atttention to keep it in good working condition. It often is out of operation for repairs, because no one in the foundry has an accurate knowledge of its parts.

It requires more thought to install and equip a molding machine and to provide suitable patterns to be worked on it than it does to make castings on the floor, and the men who operate the machine should be selected with care and judgment. The work does not require a skilled molder, nor is it a common laborer's job. The most satisfactory workman is a good molder or helper, or an intelligent foundry laborer who sincerely desires to better his condition, although a skilled molder with the proper spirit is equally as good, if not better. Qualifications of a good operator are about as follows: Previous training, 1 per cent; intelligence and willingness, 99 per cent. The operator should be taught that to understand and co-operate with the machine will increase production, an important factor in raising pay.

### *How Difficulties Were Overcome*

At the foundry of the Electric Steel Co., Chicago, we have overcome many difficulties by the use of a novel, although simple, device to obtain full benefits from the use of molding machines, and results are more than satisfactory. Our equipment is for making light or medium floor molds on a jolt machine. Because of the rapidity with which such molds can be made on a good machine a foundry frequently becomes congested, but we have solved this problem.

The molding unit, as we designate the equipment used to make the molds, is composed of two separate units connected by a floor-level trackway. The drags are made on a jolt, roll-over draw machine, manufactured by the Davenport Machine & Foundry Co., Davenport, Iowa. After the pattern leaves the flask on the equalizing table, the drag is conveyed by means of a monorail air hoist to a rack capable of holding five or six molds. This rack is made of two I-beams about 16 feet long and held parallel by bolts and spacer blocks. It rests on two dollies on the trackway, and while it is being loaded with drags it is kept in line with the drag machine.

The drags are made by one machine operator and one helper, and as the operator returns the machine to its jolt position and puts another flask on the pattern board, the helper and finisher place the drag on the rack. Here the finisher does the necessary coring, or places chills in the mold, as the job may require, and when the rack is filled with drags, it is pushed along the trackway to the cope unit, in line with cope-making machine and under the monorail that serves it.

For making the copes we use a Mumford straight jolt machine manufactured by the Hanna Engineering Works, Chicago. The copes are made by a machine operator and a helper. As fast as made they are picked up by the monorail air hoist, operated by the cope men,

and swung out over the rack, where they are deposited on the drags.

After the molds on one rack are completed they are clamped, and the rack is pushed further along the trackway, which extends about 40 feet beyond the cope machine and has space for eight or nine racks of completed molds. Here the casting is done with a crane ladle, the molds being in line with the crane. This facilitates pouring, without the usual preparatory lining up of the molds. There is no necessity for the molds being lifted from the rack and we are never troubled with "drop outs."

After the molds are poured the entire rack is picked up by the traveling crane and transferred to the shake-out floor. Here the flasks are separated, the castings and sand are removed, and the drags and copes are sent to the places provided for them near their respective machines. The rack is then placed on the floor convenient to the drag operators.

This cycle of operation is performed uninterruptedly, as it is almost independent of other work in the foundry. The only demand made on the crane is pouring the molds, transfering to the shake-out floor and the return of flasks and racks to the molding unit.

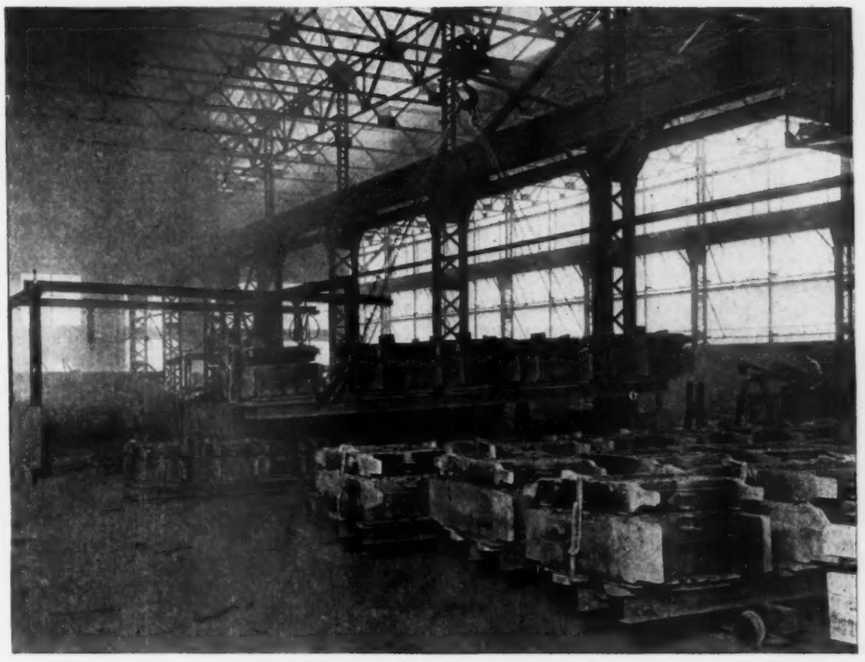
The backing-up or heap sand is all riddled at the shake-out floor and dumped into the hopper by means of a grab bucket. This hopper, which will hold enough sand for approximately five hours' work, stands directly back of the molding and cope-making machines. It is supported on a concrete base and the lower part of it forms a shoveling bench about 30 inches from the floor. This seems to be a convenient height for easy shoveling, and the men can handle much more sand than when it is necessary to lift it from the floor. The hopper also keeps the sand in a good moist condition. We have three facing boxes near the molding machine, so arranged that the operators have easy access to them. These are filled from time to time by means of a dump bucket. Cores after being inspected are loaded on skids in the core room and brought to the molding unit on a lifting truck.

At present we are working this unit two 8 hour shifts, and the 10 men thus employed are well satisfied with their work. They have often said they would rather work on this machine than on any of the several others in the foundry which are not equipped with auxiliary appliance.

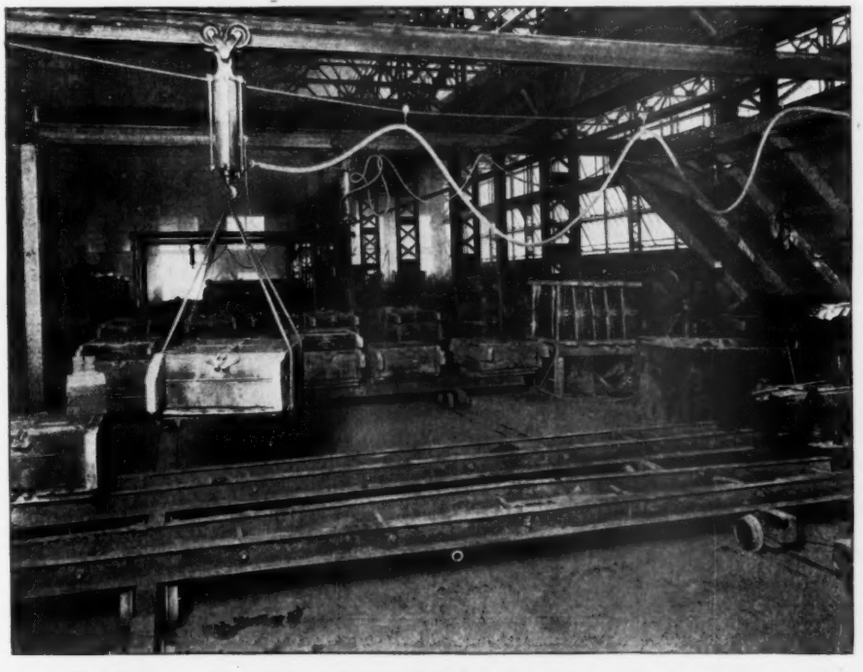
Concerning production: In a flask, 24 x 24 x 20 inches, inside dimensions, we make four castings, each requiring four cores, or a total of 16 in each mold. Average production is 23 to 25 molds per hour, or about 100 castings per hour, each weighing 18 pounds. With this same size of flask and with about the same patterns, the making of 80 to 100 molds was a very good day's production, when molds were made on machines without the hopper, hoists, and trackway, the same number of men being used in both cases.

Suitable pattern equipment is essential in successful machine production. When our patterns are mounted and ready for the foundry they go through experimental tests relating to cores, chills, location and size of gates and risers. The pattern foreman spends some time in the foundry each morning and afternoon, checking over patterns in use. By so doing we often anticipate trouble which otherwise might develop serious difficulty.

At present we are considering a supplementary addition to our molding unit. This will consist of a second wide-gage trackway about 100 feet long and parallel to the first. By means of a gravity conveyor, on which will rest a portion of the trackway, we will be able to transfer a filled rack from the track which serves the machines to this second track. This will give us a capacity of 140 molds instead of 80 as at present.



MONORAIL AIR HOIST FACILITATES REMOVAL OF THE DRAG FROM EQUALIZING TABLE TO RACK—AFTER MOLDS ARE POURED THE ENTIRE RACK IS TRANSFERRED TO THE SHAKE-OUT FLOOR



AFTER THE DRAG LEAVES THE EQUALIZING TABLE IT IS CONVEYED BY MONORAIL AIR HOIST TO A RACK CAPABLE OF HOLDING FIVE OR SIX DRAGS

# Castings for Ship Construction-XIX

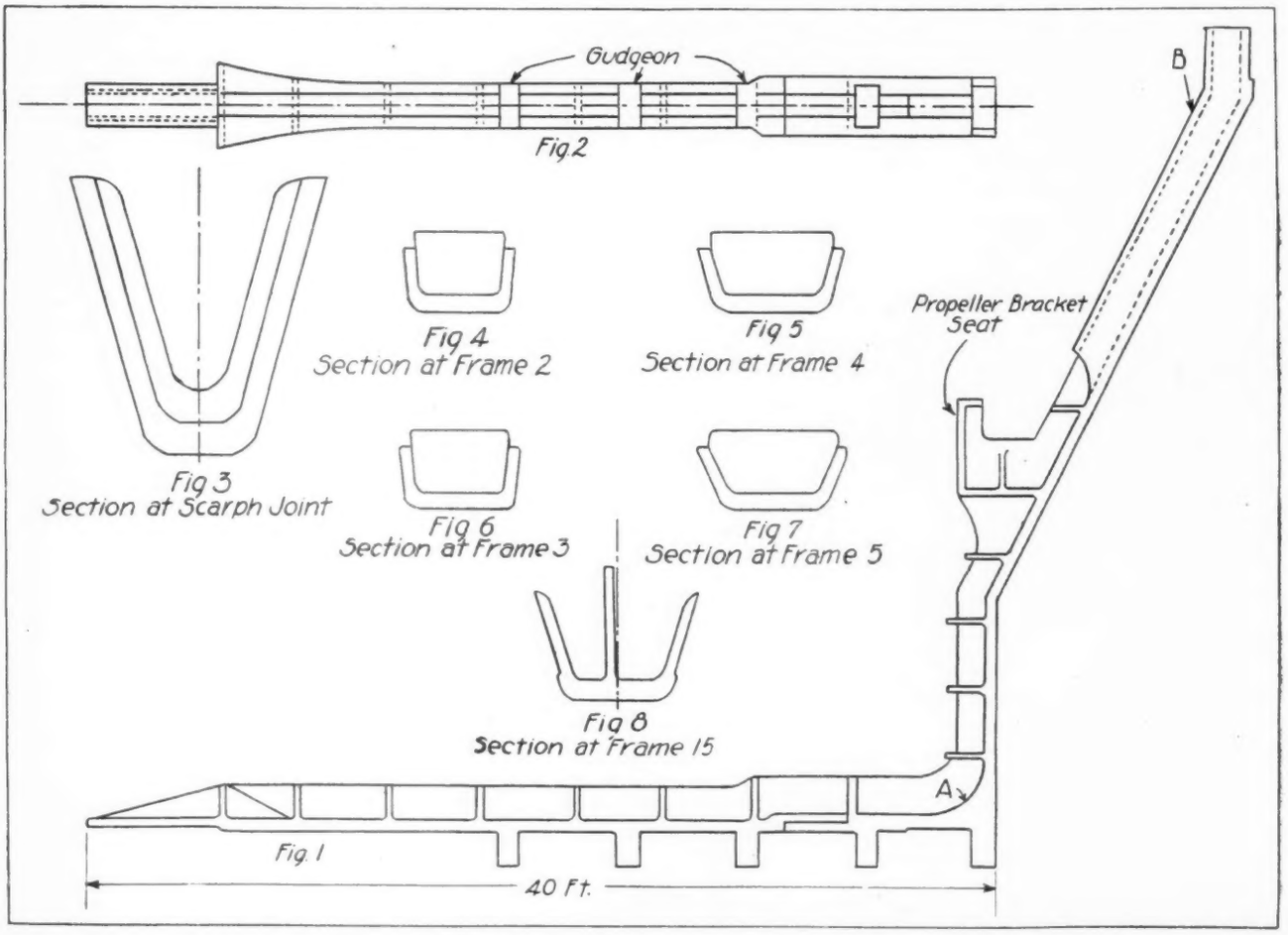
## The Greatest Care and Skill Are Required in Preparing One of These Long Rangy Patterns to Insure a Straight Casting—Accurate Fitting of the Parts Promotes Strength

BY BEN SHAW AND JAMES EDGAR

THE stern frame considered in this article differs both in size and form from those described in previous articles. It is one of the largest type used on large merchant ships. As may be seen by referring to Fig. 1, it is molded and cast in two pieces. Sometimes a large frame like this is cast in three pieces. However, even when it is not cast in two or three pieces, it generally is necessary to make the pattern in sections for convenience in handling. When this is done tie bars are fitted across the pattern joint faces, and probably upon the outer faces also. These tie pieces are heavily dowelled, so that when put together in the foundry each pattern section will be in correct relation to the other. To minimize the danger of a large casting like this being damaged, and also on account of the difficulty of gaging the correct contraction allowances, designers sometimes attach a trough sectional stiffening piece, extending from point to point, and with an arm running into the corner at *A* Fig. 1.

Figs. 1 to 10 show the stern frame drawing as it would be supplied to the patternshop. It may be mentioned that the propeller shaft bracket No. 4 was for the same ship as this frame, and had a large foot, or seat, cast on to support it. The position of the frame and the plan of the foot is indicated in Fig. 9. The section of the gudgeon or brace, as it is sometimes called, Fig. 10, shows three different diameters in the core. A straight core would be made of course to the smallest diameter minus machining allowance, and the larger diameters afterward turned out. Stock for machining also would be left on the joint of the two parts of the frame and on the propeller bracket seat. The plate *B*, Fig. 1, is for bolting on the vertical wrought-iron keel.

The patternshop is supplied with templets for the sections at the various frames as well as large templets defining the front elevation, Fig. 1. It is advisable to keep the two patterns well apart on the building floor, so that they may be built concurrently. Each piece will take a number of men several weeks to construct, and these castings generally are wanted with all possible speed to expedite the building of the ship. The usual method is for a number of men to select and prepare the necessary lumber while the work is being laid out on the floor. The gudgeons may be made and finished at the bench in time to be fitted in position when the pattern is built. The experienced




FIGS. 1 AND 2—PLAN OF KEEL PLATE AND ELEVATION OF ASSEMBLED KEEL PLATE AND PROPELLER BRACKET. FIGS. 3-8—SECTIONS AT VARIOUS POINTS SHOWING THE GRADUAL CHANGE IN THE SHAPE TO CONFORM TO THE CONTOUR OF THE STERN PLATES

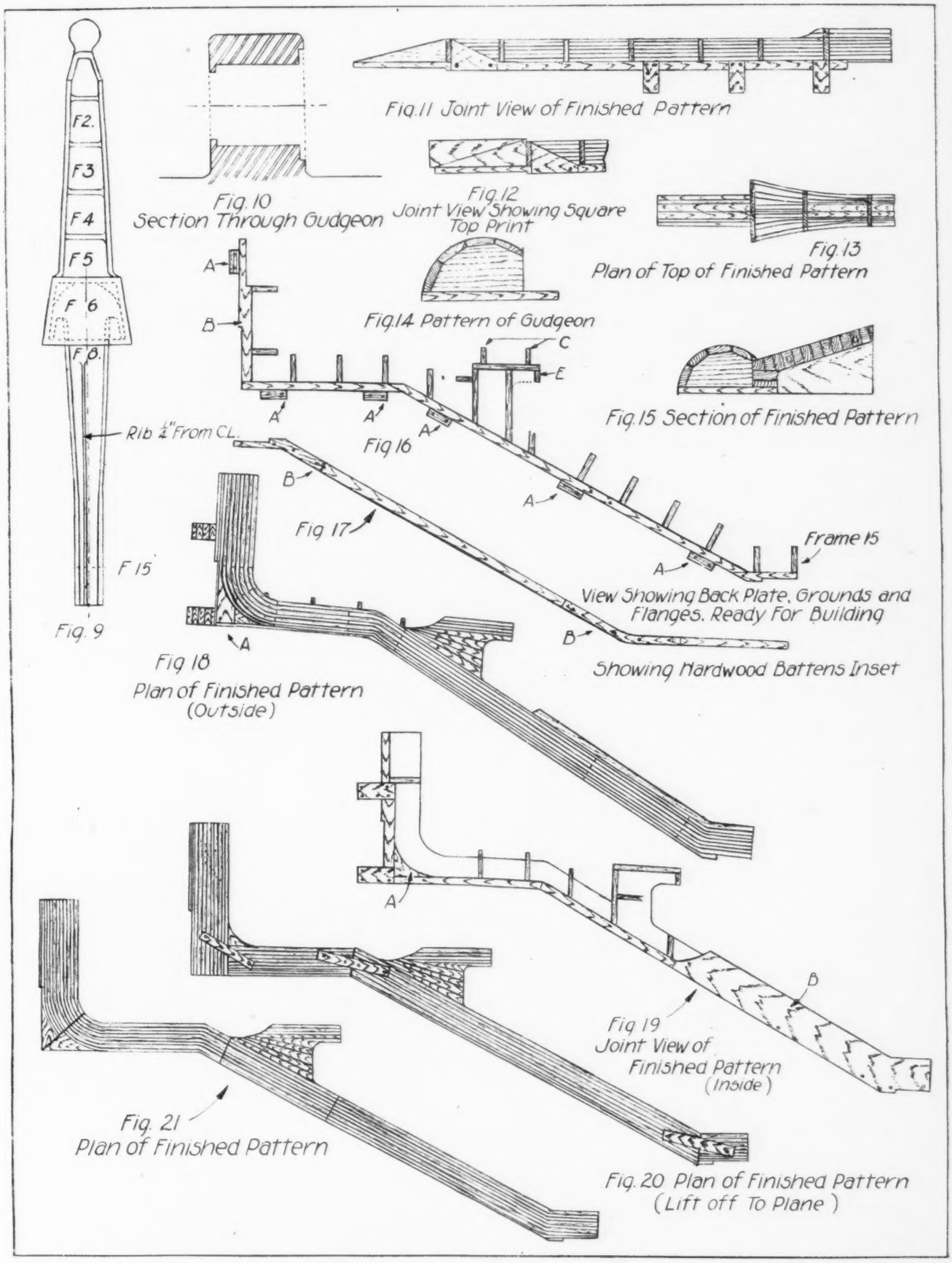



FIG. 9—ARRANGEMENT OF RIBS ON PROPELLER BRACKET FIG. 10—SECTION THROUGH GUDGEON FIG. 11—JOINT VIEW OF FINISHED PATTERN FIG. 12—JOINT VIEW SHOWING SQUARE TOP PRINT FIG. 13—PLAN OF TOP OF FINISHED PATTERN FIG. 14—DETAILS OF GUDGEON CONSTRUCTION FIG. 15—SECTION OF FINISHED PATTERN AT GUDGEON FIG. 16—FRAME FOR PROPELLER BRACKET PATTERN FIG. 17—SHOWING HARDWOOD BATTENS INSET AT THE TURNS FIG. 18—OUTSIDE PLAN OF FINISHED PATTERN FIG. 19—INSIDE JOINT VIEW OF FINISHED PATTERN FIGS. 20, 21—PLAN OF FINISHED PATTERN

layout-man can gage fairly accurately the amount of lumber that will be required for the job, and will have no difficulty in getting his squad well under way before a line is put on the floor.

The method used in the construction of the vertical post is illustrated by Figs. 11 to 15. As the gudgeons are of large diameter it is well to build them with staves screwed or nailed to bearings which are nearly circular. They do not form a complete circle and it is not necessary to close in that side which comes in contact with the main pattern. The bearings should be at least 2 inches thick, and a number of stays or battens fitted and nailed inside to prevent the grounds from being rammed in. If the gudgeons are long, stays should be used, if they are short, battens will be sufficient. The only satisfactory way of fastening the gudgeons, and the one usually adopted is to carry a plate across the face of the barrelled portion. This plate has to be checked into the joint of the frame. It is advisable to use plates about 1½ inches thick. Screws may be inserted through the bearings or through the stave that abuts the frame. They form the chief support, and if they are thin, there is a danger of the gudgeons being rammed out of place. Prints are not shown on the sketches but they have to be screwed on for core supports and ought to be about 3 inches thick.

*Alternate Methods Employed*

By reference to Fig. 2, it will be seen that the top part of this post changes from the ordinary trough section to a face plate, which is much wider than the face of the trough section. This face is supported by two ribs attached to a top plate, which is stiffened in turn by a center rib. This top part may be made a model of the required casting, or a square print may be made, Fig. 12, which will simplify the molder's work, as a drawback then will not be necessary.

One way of making the pattern is to make the top part, that is the face plate and the ribs, separately from the trough, and screw it on afterward. The alternate way is to carry out the three horizontal layers shown in Fig. 15, and then build on the additional width, which would make a stronger pattern, as this top faceplate is a few feet in length.

In building the main pattern, no notice is taken of the gudgeon recesses until after it is finished. In addition to the stiffening ribs, it may be necessary to lay down a number of additional building bearings to insure rigidity. Because of the great length of the pattern, the lagging will have to be interlaced. Some craftsmen would build the pattern with horizontal layers of lagging all the way up the slope of the trough. The objection to this, in the writer's opinion, is that feather edges which have a tendency to curl up in the mold are left when the shape is finished. If these are tacked down they make an unsightly pattern. The lagging should be 2½ or 3 inches thick. This thickness does not entail needless labor in building, and it is not too thick for screwing down.

*Finishing the Pattern*

Care must be taken that no glue gets upon the bearings as the molder will want them loose. Finishing off the shape on both the outside and the inside will be done in the usual way, by lifting the pattern to a convenient height and supporting it on legs. The outside may be finished on the floor but if channels are cut at the various given sections there will be no difficulty in finishing the distances between, when it is raised. It is important with a long pattern of this description, to have the legs all exactly the same length, as it is not possible to get a true shape with the planes if the pattern is warped. The center rib underneath the top cross section easily may be set into the joint, and also the gudgeon faceplates. The second half pattern as usual may be built on top unless the work is required in an excessive hurry, when both halves may be made concurrently on separate parts of the floor and any little discrepancies afterward corrected.

It is not necessary to supply the foundry with a coreboard for the gudgeon cores, and if a square boxed print is made between the ribs at the top of the pattern, a simple frame flask is easily made and requires no explanation.

The horizontal part of the stern frame, because of its shape, involves much more labor than the vertical part. The large foot is awkward, and there is only one practical way of making it. It would be an awkward piece of work to core out with a print and a flask, so it must be built like the rest of the pattern, the molder making his own core.

*Insert Hardwood Pieces*

It is advisable to screw buttons on the floor when building this pattern as shown at *A*, Fig. 16. They need only be 2 inches or 2½ inches square, but they afford a guide when building the edge boards which form the back of the trough. If the metal is thick, and there is no lumber in stock the same thickness, the work will have to be built in laminations from the floor upward. This method saves labor, and makes equally as satisfactory a job, if the straight pieces are jointed as shown in Fig. 16. If the width is great, it is wise practice to inset hardwood pieces about 2 inches thick as shown in *B*, Fig. 17, after the finished pattern is lifted from the floor. There then is no possibility of the joints springing if the pattern is strained. Of course, the piece *B*, Fig. 16, is strengthened in position by the large internal fillet.

In addition to the bearings, the flange and the ribs of the foot have to be set up. Like the bearings, these must not be glued. The shape of the flange is obtained from Fig. 9, and to keep it exactly square with the floor, two temporary triangular brackets may be screwed against the face *C*, Fig. 16. The back rib of the foot now may be fitted, and screwed in position from the face of the flange and the back plate of the trough, and a triangular bracket fitted against it on the outside. An additional bearing, Fig. 16, for building purposes is quite necessary as will be seen by glancing at the finished pattern, Fig. 18. There still remains the narrow rib or flange piece *E*. The flange and the back rib of this foot will be of considerable width. If dry lumber is used, the wood in the flange and back rib will warp in the sand if made from one thickness lumber. Therefore, they should be made of two thicknesses of pine crossed, or hardwood battens about 4 inches wide and ¾-inch or 1 inch thick should be set into the plates. Whichever method is adopted, the joints should be left open.

*Good Joints Are Necessary*

It is better to build the large fillet *A*, Fig. 19, of thicknesses screwed on top of each other, rather than to miter the fillet. The thin edges are better when mitered, because of the grain, but the solid fillet is a splendid support for the right-angled joint.

Fig. 18 is a view of the finished pattern. There is a choice of methods of building on the top plate, but the method outlined is easily the best. By making up the corner *A* as shown with an inside radius, a really good job can be made of the top plate. Close joints always are necessary on this class of work, but especially necessary when covering the foot. If reliance is placed on screws for drawing joints close, then as soon as the bearings have been removed, the shape naturally will alter. It may take longer to bed the pieces down to a good joint, but in the end it is well worth while. It is better to cut the lagging which covers the foot longer than necessary. The outline may be drawn afterward, when the projecting ends can be sawed and finished off flush with the foot of the stern frame.

THE FOUNDRY DATA SHEET, FEBRUARY 1, 1920

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

## DATA ON CHIMNEY DESIGN

*By J. G. Mingle*

### Correction for Friction Losses

The loss of draft due to friction within the chimney is given by the formula

$$h_f = 0.008 \frac{RV^2}{T_c}$$

where R = hydraulic radius of chimney = $\frac{\text{height}}{\text{diameter}}$

Assuming an average value of 20 for R,

$$h_f = 0.16 \frac{V^2}{T_c}$$

Fig. 3 gives the values of $h_f$ for the various chimney gas temperatures with the different mean velocities as shown.

### How to Use the Plotted Curves

*Example:* Find the available draft of a chimney 200 feet high and 10 feet in diameter, assuming an outside air temperature of 60 degrees and a chimney gas temperature of 600 degrees, the mean velocity of the gases being 35 feet per second.

From Fig. 1, K for $T_o$ = 60 degrees and $T_c$ = 600 degrees is 0.00746. Whence D = 200 × 0.00746 = 1.492 inches of water. From Fig. 2, $h_v$ for the above assumptions is 0.137 and from Fig. 3 $h_f$ is 0.183. Hence $D^1$ = 1.492 — (0.137 + 0.183) = 1.172 inches of water.

For approximate purposes $D^1$ = 0.8 D.

(*Continued on Data Sheet No.* 320)



DATA ON CHIMNEY DESIGN

*By J. G. Mingle*

(*Continued from Data Sheet No.* 319)

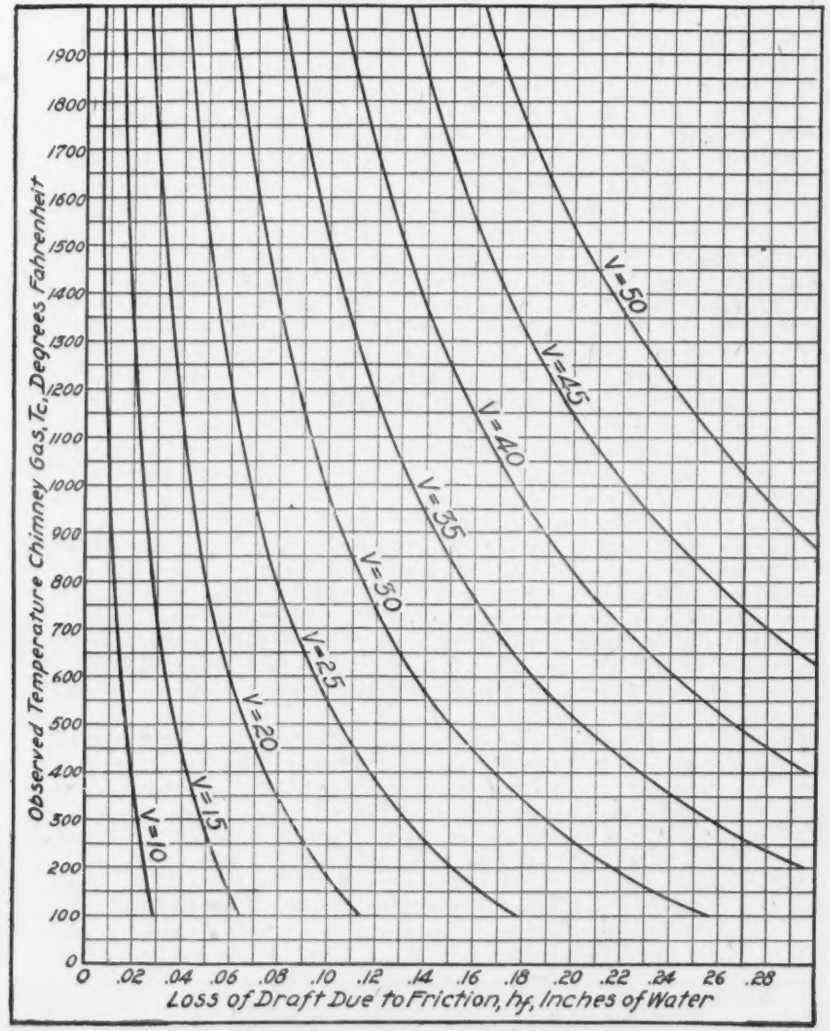



FIG. 3—CURVES GIVING LOSS OF DRAFT DUE TO FRICTION



Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

The center plate at *B*, Fig. 19, which is for the vertical keel, is checked on the joint in the usual way. In this case it is under the joint, and in order to make a close joint, a piece equal in thickness to the distance it is under, has to be screwed to the other half of the pattern.

Figs. 20 and 21 illustrate two alternate methods of making the top plates. The advantage of building them thus, is, that they can be more easily and quickly built, and also when finishing the sections can be built more easily and quickly, and also when finishing, the sections can be lifted away separately and planed straight through. The battens as seen in Fig. 20 should be fitted and should be made of thick lumber. Although these methods are cheaper, costing less in time and material, they cannot be recommended, the resultant pattern not being as rigid as when built solid. However, sometimes the foundry requires the top plates to be made in sections for convenience. The practice also has to be adopted sometimes because of the great length of the pattern, which renders it more liable to warp than a short pattern.

# How Plow Castings Are Ground and Fitted

GRINDING in the plow industry is performed either with or without the aid of moisture on the abrasive surfaces. Usually where hardened steel or chilled iron is ground the operation is wet while soft steel or cast iron is ground dry. Both the edges and the face surface of moldboards are ground. The various parts which go to make up a plow base also must be fitted to one another by grinding. The material in moldboards generally is either chilled cast iron or hardened steel, although at times they are furnished in soft steel.

The methods of grinding plow parts vary with the different shops. Wheels 20 to 24 inches in diameter and 2½ to 3½ inches thick are used. In some plants a cradle located underneath the wheel and pivoted at one end is used for holding the work against the wheel. It is provided with two handles on the front by which the operator manipulates the whole device. In other shops the work is held against the wheel by hand and in one or two cases swing frame machines have been used. As a general rule the grinding on moldboards is most successfully done with wheels from 16 x 3 inches to 30 x 3½ inches, which are beveled on both sides. Landslides are ground on the edges and sides. They also are fitted to the other plow parts by grinding. Usually the operation is offhand using wheels from 14 inches diameter up to 2 inches or more in thickness.

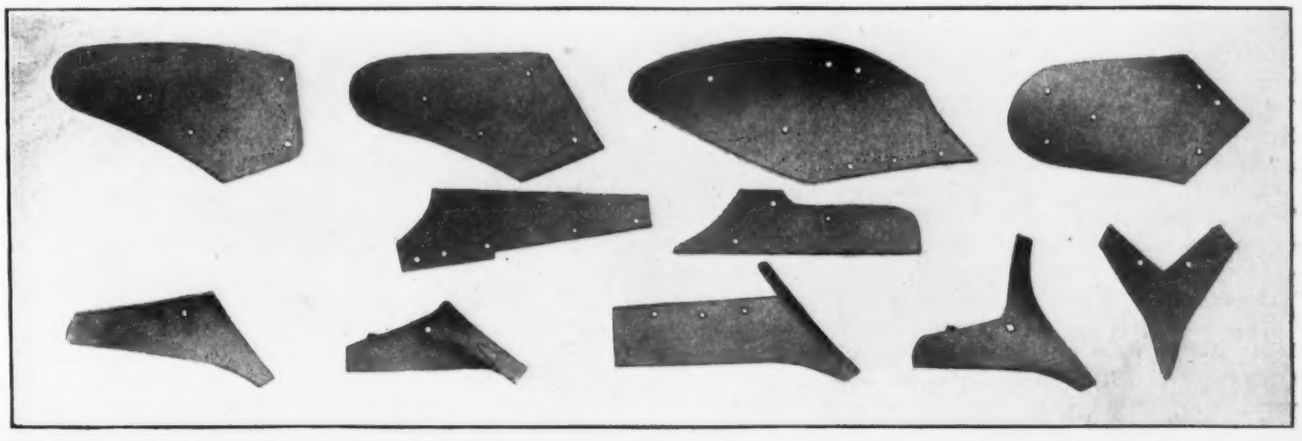
Shares and points are ground as integral parts of the whole after the plow base has been assembled. They also are ground separately as repair parts or when fitting or shaping the pieces during, or prior to, the assembling process. Shares and points are made of chilled cast iron, hardened steel, or soft steel. The grinding is done on wheels from 18 to 30 inches in diameter and 2½ to 3½ inches thick. Smaller wheels are used occasionally, depending on the equipment or methods in the various plants. In the fitting operation the grinding usually is done offhand but for surfacing the work, a cradle similar to that used in moldboard grinding is employed. The edging, or jointing of the plow shares is accomplished by using a cylinder wheel on a special jointing machine. The work may be clamped to the bed of the machine and traversed past the wheel by hand. The cylinder wheels generally used are about 16 inches diameter by 8 inches thick, with a 2-inch rim.

When the various parts of the plow have been assembled, they are ground again to finish up rough edges and to remove protruding rivets or bolt heads. The full length of the joint between the moldboard and the share is ground for a width of 4 to 6 inches, to even the joint and produce the proper curvature at this point. This operation is carried out on wheels from 24 to 30 inches in diameter by 2½ to 3½ inches wide, using the cradle for holding the work securely against the wheel while it is being ground.

The final finish is produced on the various plow parts with abrasive grain glued on polishing wheels. The kind of wheels used may vary in different shops depending on local conditions. Compressed polishing wheels are used in some plants and stitched cotton buff wheels have been found more successful in others.

A cradle is used in some cases to apply the work to the wheels, and in other cases the work is held by hand. The method employed depends somewhat on the shapes and sizes of the parts to be polished and upon the available equipment in the various shops. A cradle arrangement with attachments to hold the parts being polished usually enables the operator to turn out more work as all the force employed serves to press the work firmly against the wheel.

Abstracted from "Plow Grinding," by G. A. Park, in the December, 1919, issue of *Grits and Grinds*, published by Norton Company, Worcester, Mass.



THE UPPER ROW OF CASTINGS ARE MOLD BOARDS, THE TWO IN THE CENTER ARE LAND SIDES, WHILE THE LOWER ROW ARE SHARES AND POINTS

# Premium System in the Pattern Shop

## An Example Shows in Graphic Form the Results Accruing from the Practical Application of One Variety of Premium System — Time Reduced 35 Per Cent, Wages Increased 83 Per Cent

BY JOHN H. KLEE

AN ARTICLE entitled "Applying the Premium Plan to a Pattern Shop," by D. M. Avey, which was published in the March, 1919, issue of THE FOUNDRY aroused much interest. On various occasions since that time my opinion has been asked regarding the application of the system. The nature and number of inquiries has led me to believe that some of the readers must have skipped through the article hurriedly and did not fully grasp the details while others who had simply heard of the plan in a general way wanted to get accurate first-hand information. The figures which are here submitted represent my own individual earnings as a patternmaker at the Cleveland foundry of the Westinghouse Electric & Mfg. Co. for a period of three months in June, July, August and September, 1917. The system was in full and satisfactory operation at that time. When it was first introduced it met with considerable opposition from the men, due probably to the fact that its provisions were not fully understood and also because there is a general disposition on the part of the average workman to regard with suspicion any overture on the part of the employer. However, the system gradually won the men's approval. It was in successful operation when D. M. Avey secured material for the article referred to and is still in existence to the mutual satisfaction and profit of the men and the company.

The opportunities offered by this or any other system made to fit local conditions and arranged on a basis fair to both employer and employe should appeal to every live and energetic man and serve as an incentive to greater production. In its last analysis it may fairly be described as a profit sharing plan; the net results of which are that the employer gets the same production with a smaller number of men; and the men get greater remuneration in a given time. In the specific case under consideration the company was able to reduce its staff 33 1-3 per cent or from 90 men to 60 while the average earnings of the men taken over a period of three months as shown in the accompanying table were increased from $304.72 to $557.45, or 83 per cent.

### Wages Earned With and Without Premium

| Date of paydays | Actual hours worked | Hours saved | Employe's share 50 per cent | Hours paid for |
|---|---|---|---|---|
| June 30 | 85 | 81.5 | 40.75 | 125.75 |
| July 15 | 94.5 | 76.1 | 38.05 | 132.55 |
| July 31 | 123 | 133.5 | 66.75 | 189.75 |
| Aug. 15 | 113.5 | 150.8 | 75.40 | 188.90 |
| Aug. 31 | 123 | 150.5 | 75.25 | 198.25 |
| Sept. 15 | 47 | 174 | 87.00 | 134.00 |
| | 586 | 766.40 | 383.20 | 969.20 |

| Pay received | Pay computed at flat rate | Saved for company | Increase for workman | War bonus monthly |
|---|---|---|---|---|
| 65.40 | 44.20 | 11.20 | 11.20 | |
| 67.95 | 49.14 | 18.81 | 18.81 | 26.25 July |
| 98.65 | 64.06 | 33.59 | 33.59 | |
| 98.20 | 58.92 | 39.28 | 39.28 | |
| 103.10 | 64.06 | 39.13 | 39.13 | 28.20 Aug. |
| 69.70 | 24.44 | 45.26 | 45.26 | |
| 503.00 | 304.72 | 199.28 | 199.28 | 54.45 |
| 54.45 Bonus | | | | |
| $557.45 | | | | |

586 hours at a flat rate of 52 cents an hour would amount to ..... $304.72
586 hours under the premium system ..... 557.45

Difference in favor of the premium system ..... $252.73

In comparing these figures it must be borne in mind that they are for 1917 when the maximum rate for patternmakers was 52 cents an hour. A comparison based on the present rate of wages would show still more astonishing results.

Without going into detail of how the rates and prices were established, a point which is covered fully and clearly in D. M. Avey's article, a summary will be sufficient in this case. A certain number of hours is allowed for making each job. For every hour which the patternmaker reduces that time he is credited with half an hour on his time card. In addition he is given a bonus at the end of each month for perfect attendance equal to half of his total extra time. For instance if 10 hours are allowed for the job and he makes it in 8 hours, he is entitled to 9 hours pay, and if he works steadily every day in the month the 9 hours would be credited as 9½ hours. The net results of the system may be briefly summed up as follows:

To the employe: Increased earning power; constant and greater interest in his work, and the satisfaction of being compensated according to his personal efforts and not by an arbitrary standard whereby the competent must carry and support the incompetent, the frivolous and the lazy. To the employer: A considerable saving in invested capital; greater production with less employes; saving of factory space per unit of output, and more and better co-operation from the workmen who for the time being have become business partners in the company. The mechanic of today with his greater opportunity to acquire a better education has become a thinker. It is being recognized that greater production cannot be effected by the old methods of driving. The ideal foreman of today is a leader and not a driver. A greater interest must be awakened and an incentive must be offered to induce men to use their thinking powers in connection with their daily work. This in turn will result in cutting out all superfluous and lost motion, and will create a desire on each man's part to perform his work in the shortest possible time and in the most efficient manner.

The ideal system of compensation of course would be one by which employer and employe shared losses as well as profits. With the passage of time and better educational facilities such a system may be eventually adopted.

The author, John H. Klee, is in charge of the wood, pattern and foundry work, and co-ordinator of industrial training at the West Technical high school, Cleveland.

# Tire Molds Are Made As Specialties

## Design of Building and Mechanical Equipment Responsible for Maximum Production on Comparatively Difficult Castings—Automobile Tire Molds and Cores Made by Unskilled Labor

PHENOMENAL growth during the past decade has earned for Akron, O., the title of "The City of opportunities"; and truly a city whose population has jumped from 70,000 at the last federal census to an estimated population of 200,000 at the present time can fairly lay claim to that title. This expansion is due principally to the establishment and growth in the city of the largest factories in the world devoted to the manufacture of rubber products; factories which in turn owe their existence to the tremendous proportions which the automobile industry has reached in recent years. Their main output consists of automobile tires and tubes, and an idea of their total volume of business may be gained from the fact that one of them alone turns out 20,000 tires a day.

The casting industry, which plays such an important part in every walk of industrial life, naturally takes a prominent place in the equipment and operation of every process through which the raw material passes from crude rubber and fabric to the finished tire. The demand for castings grew in proportion to the growth and expansion of the tire business and as a result existing foundries were enlarged and many new ones placed in operation. Among the new foundries is that of the Portage Foundry Co., Barberton, O., which was erected about two years ago for the purpose of making automobile tire core and mold castings in quantity along modern lines. The foundry was built and equipped under the personal direction of the present manager, J. A. Lanigan, a well known engineer and foundry manager of broad experience. He drew freely from his accumulated foundry knowledge in designing the building and installing the most efficient equipment, a considerable amount of it being his own design; and when the foundry was ready he engaged and trained an operating force to secure maximum results.

The shop is 200 feet long by 90 feet wide by 15 feet high at the eaves. It is of brick and steel construction and is exceptionally well lighted by a continuous sash 10 feet high extending the full length of the building on both sides. Additional direct overhead light is supplied by a double row of windows in the Pond truss roof. The roof of the main building is the built up type. It is supported on a steel frame and covered with asbestos. The roof over the cupola section is covered with cement slabs.

A space 20 feet wide at one end, extending the full width of the building is partitioned off by a fireproof brick wall extending from the floor to the roof. This space is further subdivided and serves as an office, store room, tool room and pattern storage. A new pattern storage building is under consideration.

The molding and casting floor is 60 feet wide and extends the full length of the building with the exception of the space already mentioned. The remaining 30 feet of floor space is taken up by a core room 42 x 30 feet; a wash, toilet and locker room 18 x 30 feet; a cupola installation 40 x 30 feet and a chipping and cleaning room 80 x 30 feet. They are located in the order indicated which brings the cupola to the center of the shop. The molding floor is divided into nine self-contained independent units. Each one is fully equipped and may be operated individually or in conjunction with the other units, depending on the volume of business. Each one is provided with a molding machine and a 2-ton, 20-foot span traveling hoist. The bridge and traveling gear on these hoists was furnished by the Northern Engineer-

FIG 1—THIS TYPE OF LADLE ELIMINATES THE NECESSITY FOR BUILDING LONG RUNNER BASINS

FIG. 2—ONE OF THE JAR-RAMMING ROLLOVER MACHINES—NOTE LOCATION LINES IN PLATE

ing Works, Detroit, and the air hoists with which they are provided were supplied by the Curtis Pneumatic Machinery Co., St. Louis.

The molding machines are located at the back of the floors near the windows, assuring an abundance of light. A 24-inch gage industrial track in the middle of a concrete gangway passes all the floors on the cupola side and serves to convey the iron to each floor. It also serves the trucks at night in transferring the castings to the cleaning room. The molding machines all are the jar-ram rollover type built by the International Molding Machine Co., Chicago, and range in size from 26 to 48 inches. A special feature incorporated in their design for this particular job is the short stroke of the pattern drawing cylinders. The patterns used for making the castings in this shop all are comparatively shallow and a drawing device with a range of 6 inches is ample to meet all requirements. The pattern plate on each machine has two lines at right angles across the diameter. A number of dowel holes are drilled on these lines at regular intervals to accommodate and locate patterns of varying diameters. To avoid a multiplicity of flasks the bars in the copes and drags are cut out to clear patterns within a given range of diameters. No bottom boards are used, the drags are barred the same as the copes and the only difference experienced in ramming them is that the copes are gaggered while the drags are not.

The smaller sizes of machines are used for making the castings known as "cores." These are the castings on which the fabric of the tire is built and shaped. The castings which are destined to form the outside of the tire are made on the larger machines. The inner, or core casting is a plain ring with a section like that shown at *A*, Fig. 3. It is molded from a split pattern and has an average metal thickness of 5/8-inch. The cores for some of these castings are in one piece while others are in four sections as shown at *B*, Fig. 3. In the first instance the entire vent of the core passes off through one 3/4-inch print; in the second a vent is provided for each section. The castings having the four cores afterward are sawed apart through the metal thickness. This difference of design is made because an entire ring casting cannot be extracted from some types of tires but must be taken apart and removed in sections. It will be noted that one of the cored sections *C*, Fig. 3, is the key which must be removed first. Several molds for the casting known as the mold which forms the outside of the tire are shown in Fig. 4. Cast-iron, one-piece chills are rammed in the drag with the pattern and form the groove in the casting. These chills, together with the special iron with which the castings are poured and which will be referred to later, serve to impart a dense close grain to the iron forming the finished face of the casting. Under ordinary circumstances the pocket all around the rim, Fig. 4, would be formed in green sand and lifted as an integral part of the cope. The skill required to do this and the risk attached are eliminated by providing a continuous core print around the periphery of the pattern. When the pattern is drawn a ring core, made in sections for convenience in handling, is set in the print. On account of these cores a flat cope is all that is necessary.

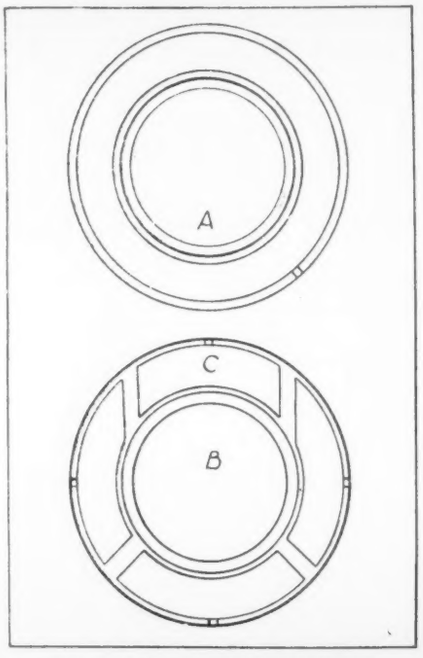



FIG. 3—PLAN OF CORE DISTRIBUTION

The core castings are poured from two branch gates at the joint attached to a common center runner. The molds are poured through four or six horn gates attached to a similar runner. The

FIG. 4—DRAGS FOR MOLD CASTINGS—NOTE GATES, ALSO CORES AROUND THE RIM

layout is clearly shown in Fig. 4. The system of gates and methods of pouring are particularly ingenious and effective. They were devised and introduced by the manager, J. A. Lanigan. The castings must be perfectly clean and therefore strainer gates are provided. A round block consisting of a core print, a basin and set of gates is centered on the pattern plate and rammed up with the drag. When the drag has been turned over the block is withdrawn and a flat core containing several ¼-inch holes is dropped into the print.

The usual long pouring basin on copes of this character is not used. A round gate stick about 4 inches in diameter is rammed in the center of the cope. This is taken out after the cope has been rammed and the hole reamed out in tapered fashion to serve as a pouring sprue.

Ladles of special design, one of which is shown in Fig. 1, are used for pouring the castings. The convenience of this method of pouring will be apparent to any one familiar with foundry work. The long nose of the ladle reaches over and pours a stream of iron from a minimum elevation directly down the vertical runner. Among the advantages of this system may be noted that the long narrow channel in the nozzle of the ladle acts as a self skimmer; the stream of molten iron may be controlled and directed perfectly and the danger of the falling stream cutting away the end or side walls of a long built up basin, with the attendant mess floating into the runner, is eliminated.

Ordinary labor has been trained to perform all the molding labor in this shop and so efficient are the rigging and appliances provided that each gang of three men puts up 40 core molds a day and each gang of four men put up 22 of the outer molds. The pouring is performed by four men who experience no trouble in distributing 40 tons of iron a day throughout the shop. The cupola, as will be noted in Fig. 5, is mounted on unusually high supports. The metal is tapped into a 3-ton, geared ladle which serves as a mixer and reservoir. From this ladle it is poured into the special pouring ladles previously described. These ladles also are geared and mounted on suitable trucks operat-

FIG. 6—SHOWING ARRANGEMENT OF FURNACE, RESERVOIR LADLE AND ONE OF THE LADLES USED FOR POURING THE CASTINGS

FIG. 5—CHARGING PLATFORM—NOTE THE LOW AND WIDE DOOR—THE CHARGING CARS ARE PUSHED CLOSE TO THE DOOR AND THEN DUMPED

ing on the narrow gage track previously referred to which passes across the front of each floor. Pouring ladles have a capacity of one ton each. The crane runway over each floor extends over the track and as the ladle reaches each floor it is lifted off the truck and carried along the row of molds. Molding operations are not suspended during casting time. The cranes which serve the molding machines also are used for pouring the iron, but since one uniform grade of iron is used for pouring all the work, whichever crane is temporarily idle is called to pour the iron from each tap. In this way congestion is avoided and by a general rule of averages all the floors receive iron at about the same rate.

The castings are shaken out by a night gang; the flasks piled up on both sides of each floor and the sand cut over by a sand-cutting machine supplied by the American Foundry Equipment Co., New York.

A cupola made by the Whiting Equipment Co., Harvey, Ill., and lined to 60 inches is used for melting the iron. Before bricking it the manager cut away and enlarged the opening communicating with the tuyeres and installed a continuous tuyere, 8 inches high instead. This was his own design. The blast is furnished by a P. H. & F. M. Roots positive pressure blower driven by a 40-horsepower General Electric motor. The coke bed which is ignited by an oil burner supplied by the U. S. Chaplet & Supply Co., New York, consists of 2000 pounds of coke; this is followed by alternate layers of 4000 pounds of iron and 400 pounds of coke. The iron melts hot and comes down at the rate of 15 tons an hour.

*Iron Readily Machined*

A strong, hard iron, yet one that can be machined readily is what is desired. A mixture which fills these requirements and gives excellent results is made from low sulphur, low phosphorus, high manganese pig iron, cast iron scrap and steel scrap in the following proportions: Pig iron, 30 per cent; cast iron scrap, 55 per cent, and steel scrap, 15 per cent. This mixture yields the following analysis: Silicon, 1.75 per cent; sulphur, 0.07 per cent; phosphorus, 0.30 per cent; manganese, 0.80 to 1 per cent.

On account of the high supports under the furnace the charging floor is correspondingly high. This arrangement provides room for a mezzanine floor which is utilized for housing the blower and air compressors. One compressor built by the Ingersoll-Rand Co. has a capacity of 520 cubic feet of air per minute. It is driven by a 40-horsepower General Electric motor and supplies all the air used during the day. The small machine, driven by a 10-horsepower General Electric motor and manufactured by the Curtis Pneumatic Machinery Co., St. Louis, Mo., has a capacity of 58 feet of air per minute, and supplies air for the night men in shaking out the flasks and loading castings.

The charging floor shown in Fig. 5 is large and roomy and is unusually well lighted and ventilated by large pivoted steel sashes. As may be noted in the illustration the charging door is flush with the floor, a feature which facilitates the work when it is necessary sometimes to charge the furnace by hand. The hoist shown in front of the charging door in Fig. 5 is used for dumping the contents of the charging boxes into the cupola. The design of the cupola room provides for an additional furnace should conditions warrant such a step.

An electric elevator built by the Haughton Elevator Co., Toledo, is used to convey the iron and coke from the floor level to the charging floor. The floor of the elevator is provided with a turntable and section of track corresponding in gage to the track laid on the floor and also in the stock yard. The charges are made up outside. The transfer track scale shown in Fig. 7 is used for weighing the charges. It is mounted on four wheels which travel on a depressed track. Short lengths of track are laid on the ground level and at right angles to the depressed track. These short tracks lead on one side to the piles of pig iron and scrap and on the other side to the coke pile. The traveling scale may be set near any of these track on which a car may be loading. When the loaders judge that there is nearly enough material

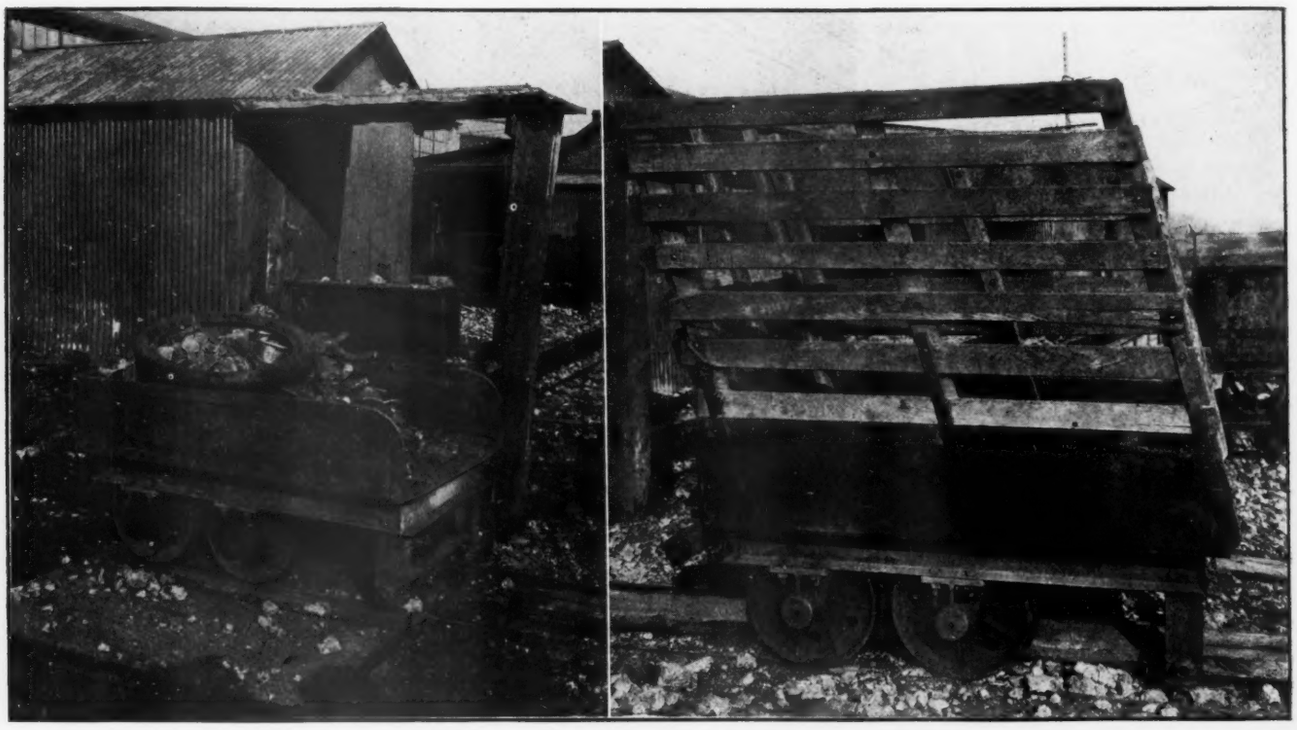


FIG. 7—THE TRAVELING PLATFORM SCALE IS USED TO WEIGH EACH CAR OF MATERIAL BEFORE IT GOES INTO THE FOUNDRY FIG. 8—ONE OF THE CHARGING CARS CONVERTED INTO A COKE CARRIER

on a car they shove it on the scale and finish loading it there. The car is then pushed along the track until it comes opposite the track leading to the cupola elevator. The charging car is taken off the scale car and pushed along the track on to the elevator. The car for handling the coke is shown in Fig. 8.

The core room is separated from the molding floor by a low brick wall about 5 feet high. A smooth concrete floor facilitates the work of a lifting truck used for carrying the loaded core racks into and out of the ovens. In addition to the ovens and core racks which were built under the direction of James A. Lanigan, the core room equipment includes one 6-foot Simpson pan mill made by the National Engineering Co., Chicago; one Standard sand mixer furnished by the American Foundry Equipment Co., New York, and one Combs gyratory riddle. A standard mixture is used for all the cores. It consists of Michigan City sand bonded with a core oil supplied by the E. J. Woodison Co., Detroit. It is mixed in the proportion of 60 parts of sand to one of oil. The location and size of the ovens and also the general features of the racks used for drying the cores are shown in Fig. 9. The racks were built locally and the core plates supplied by the Wadsworth Core Machine & Equipment Co., Akron, O. The cores all are made by female labor.

The four ovens are built *en bloc*. Each one measures 5 x 7 x 12 feet and has a capacity of two core racks. The fireplace is situated in a chamber under the floor. The heat from the fire is carried through a brick flue which passes under the floors near the end of each oven and terminates in a steel stack. A damper is provided in the flue near the stack and is left open until the smoke incident to starting the fire has ceased. A second flue under the other end of the oven, but not connected with the fireplace is provided to insure an even distribution of heat. The openings in the oven floors connecting with the flues are covered with iron plates which can be slipped backward and forward in cast-iron frames. By adjusting these cover plates individual control can be exercised and any, or all of the ovens may be heated at one time.

The chipping and cleaning room is situated at the opposite end of the 30-foot bay from the core room. Two large square tumbling barrels supplied by the W. W. Sly Mfg. Co., Cleveland, are provided for removing the sand from the castings. One measures 4 x 4 x 6 feet and the other 3 x 3 x 6 feet. One hand traveling crane built by the Northern Engineering Works, Detroit, and equipped with a 2-ton electric hoist

FIG. 10—PART OF A FLOOR OF CORE MOLDS—NOTE THE POURING SPRUES

FIG. 9—SHOWING THE OVENS AND CORE RACKS—THE WORK BENCHES ARE SITUATED ALONG THE WALL NEAR THE WINDOWS

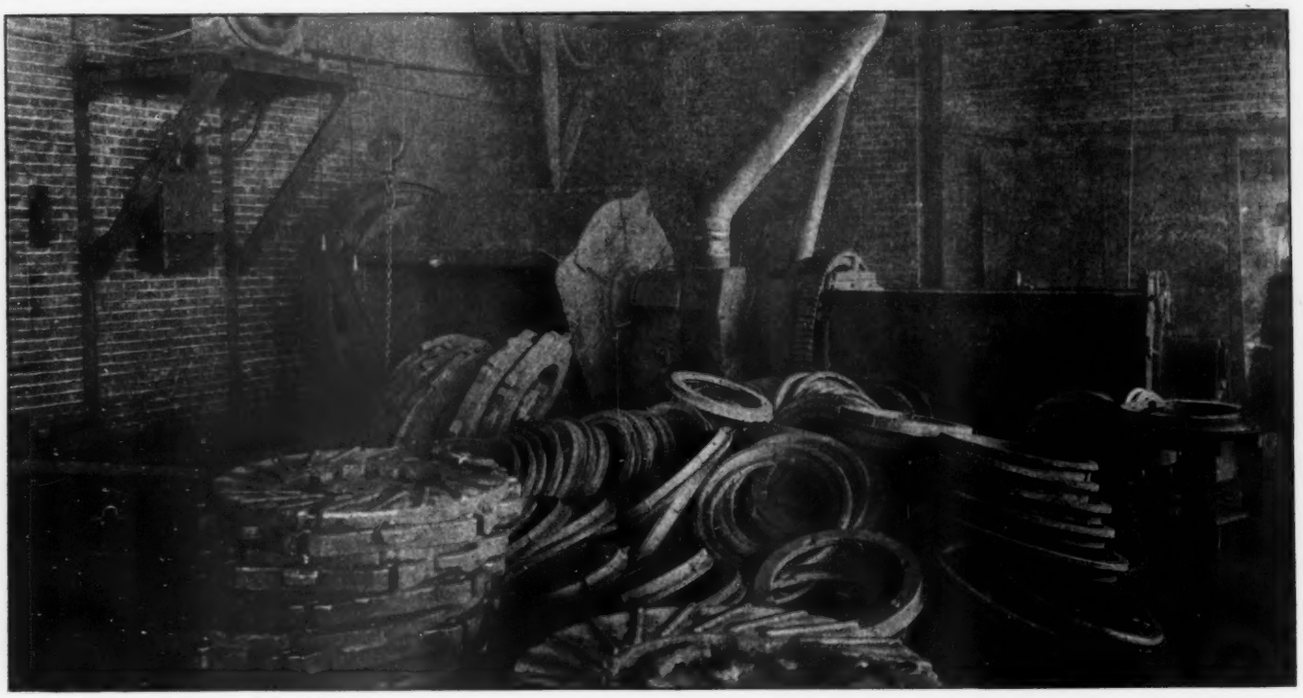


FIG. 11—ONE END OF THE CLEANING ROOM SHOWING CHILL AND RING CASTINGS—ALSO THE TUMBLING BARRELS WHICH ARE EQUIPPED WITH DUST ARRESTERS

built by the Euclid Crane & Hoist Co., Euclid, O., is used for transferring the castings from the trucks to the tumbling barrels and back again. A pillar crane at one side equipped with the same type of hoisting gear serves for lifting the castings on to the chipping bench and also loads them for shipment.

A sandblast unit is being installed by the W. W. Sly Mfg. Co. at the present time and probably will be completed soon. A special feature designed by the manager and incorporated to meet peculiar conditions in this plant is a monorail conveying system. It is a continuous track made up of two straight sections and two turns, one at each end. One of the straight sections passes through the sandblast chamber while the other, on the outside, furnishes an opportunity to load the castings on to a row of pendant hooks suspended from rollers operating on the lower flange of the monorail I-beam. It is practically a continuous performance. The castings are placed one on each hook; they go in at one door of the sandblast chamber dirty and come out at the other door cleaned ready for the chippers. As they come out of the second door they are removed from the hooks and replaced by others. With this installation a constant stream of castings can be kept moving through the sandblast chamber with a minimum of effort. Each hook is attached to a small chain block for swinging the castings clear of the floor.

Molding and core sand are stored in a building lying between a spur of the main line track and the depressed track in the yard. Sand arriving in cars is unloaded directly into openings in the roof of the building. Partitions serve to keep the different varieties of sand separated.

## Enameling Cast Iron Domestic Wares

Enameling metals is a relatively old art, but its general application to household and industrial articles represents a comparatively recent development. In the last few years the production of enameled cast-iron and sheet-steel wares has attained a position of considerable economic importance.

"Materials and Methods Used in the Manufacture of Enameled Cast Iron Wares" is the title of a treatise by Homer F. Staley, issued by the bureau of standards, Washington. Copies may be had by applying to the superintendent of documents, government printing office, Washington. The paper which in this instance is a fair sized book of 158 pages, 10 x 6½ inches, deals with the materials and methods employed in the manufacture of enameled cast-iron wares. Considerable attention is given to the sources and methods of preparation of these materials, as well as to their properties and effects when introduced into the enamel composition. Methods of calculating enamel formulas and examples of the compositions of enamels of various types are given. The defects in enamels, their causes, and the remedies to be used in overcoming them are discussed. Manufacturing methods and equipment used in compounding the enamels, making and preparing the castings, and applying the enamel are also outlined.

The wet process is simply touched upon in passing but the treatise deals in detail with the enameling of cast iron by the dry, or American process. In this method of manufacture the thoroughly cleaned casting is painted with a suspension in water of powdered glass, clay and other materials. This suspension is known as the ground coat. The casting is then heated until the ground coat is thoroughly fused, forming an extremely thin layer of transparent glass on the casting. The piece of ware is withdrawn from the furnace, and immediately coated by means of long-handled sieves, with a layer of opaque, white, powdered glass, known as the cover-coat enamel. The casting is returned to the furnace for a couple of minutes during which the cover-coat enamel fuses to a smooth layer. Two such layers of cover-coat are usually applied, giving a total thickness of 1/32 to 3/32 inch.

Under the direction of John O'Brien and David Goldich, the Universal Bearing Bronze Co., Winsted, Conn., has started the manufacture of aluminum castings, rough and finished, in a portion of the old Goodwin & Rintz factory buildings.

# Review States Plumbago Situation

## The Large Stock of Plumbago Built Up During the War Has Caused a Temporary Over Supply Since the Demand Has Slackened — Benefits of Tariff on Plumbago Questioned

BY CHARLES E. PETTINOS

SINCE the armistice there has been a great falling off in the demand for Ceylon plumbago, as well as for flake graphite. The principal reason for this is the slackening of demand for crucibles. Some flake graphite has gone into the manufacture of crucibles, but the amount so used was probably only about one-tenth the amount of Ceylon plumbago used for crucibles.

At the height of the demand for ceylon plumbago, which was the latter part of 1916 and virtually all of 1917, prices c.i.f. New York were as high as 32.00c per pound for lump, 25.00c per pound for chip and 14.00c per pound for dust. The difficulty of shipment, high marine freights and war risk insurance all played their parts in making these prices.

Beginning with 1918 there was a fair supply of Ceylon plumbago in the country and afloat, and prices began to come down. On March 23, 1918, the war trade board ruled that no graphite importations were to be allowed after April 5 and until July 1 of that year. Beginning with July 5000 tons were to be allowed for the remainder of the year. This was because the war trade board, after a thorough investigation of stocks in this country and afloat, decided that the supply would be ample under its ruling, especially considering the fact that it expected the crucible manufacturers to use domestic graphite up to 20 per cent of the total amount of graphite employed. This action was due primarily to the fact that freight space was scarce and was needed for other commodities.

### *Shipments Stopped*

Early in July the war trade board changed its ruling and decided that no graphite should be imported during the remainder of the year. This was because there still was an ample stock of graphite in the country. In the meantime, however, more freight space on vessels became available, and on Oct. 2, this latter restriction was modified. In consequence several thousand tons of plumbago were ordered forward, most of it arriving late in 1918 and some early in 1919. On Jan. 16, 1919, all restrictions on importing graphite were removed by the war trade board.

Due to the lessening demand for crucibles during the latter part of 1918 and because of the heavy shipments of plumbago about that time, the armistice found the market in a poor condition to absorb more stock. The crucible manufacturers were well supplied for months to come and there were large quantities of flake graphite in storage awaiting purchasers.

The ending of hostilities, which meant cessation in the manufacture of war materials, caused a tremendous let-up in the use of crucibles, some crucible users having been doing 100 per cent war work. The first half of 1918 saw little or no business either in the production of plumbago or of crucibles, most of the old stock of plumbago remaining intact in the hands of the crucible makers.

### *Exports from Ceylon*

Gradually the business has picked up and a fair volume has been done the latter part of 1919, although much of the old stock is still on hand. The following tonnages will give an idea of the great variation in the business done.

In 1916 about 33,000 tons were shipped to all countries, England taking about 7500 tons and the United States about 24,000 tons. In 1917, the total exports from Ceylon were 26,700 tons. Of this England took about 4000 tons and the United States about 22,000 tons. In 1918, the total exports dropped to 16,000 tons, England taking 6400 tons and the United States 8500 tons. The total exports from Ceylon for the first half of 1919 were 4000 tons, England taking 1300 tons and the United States 2500 tons.

Marine freight rates during the period just mentioned were extremely irregular. The normal freight rate before the war was about 33 shillings per English ton from Colombo to New York. During the war, the rate rose to 560 shillings per ton. In 1918 it came down very rapidly, reaching 120 shillings per ton about the middle of the year. This was partly due to competition of Japanese lines which were booking direct to America.

In the fall of 1919, marine freights stiffened, going up to 220 shillings per ton, around which point they have held fairly steady. Prices of graphite also came down reaching the lowest point about the middle of 1919. At this time graphite prices were in the neighborhood of 13.00c per pound for lump, 10.00c per pound for chip and 7.00c per pound for dust. Since then, owing to stiffening of the marine freight rate, and also because of the premium on the Indian rupee, prices have advanced as high as 3.00c per pound on some grades of plumbago. That is about the situation today, with very little business being done.

Labor conditions in Ceylon have been affected as in all other parts of the world, and wages probably will never get back to where they were before the war. There is, of course, a point where plumbago operations are unprofitable, and that point has about been reached.

During the greatest activity in 1916 and 1917 about 13,000 mines or pits were in operation in Ceylon, employing upwards of 20,000 men. At the beginning of 1919, 263 mines were in operation, employing about 6400 men. The entire normal production of plumbago in Ceylon covering a period of years has been about 30,000 tons per year.

There are two chief sources of supply of flake graphite; the island of Madagascar and the North American continent, the latter including areas in New York, Pennsylvania and Alabama and in the Buckingham district of Canada.

### *Sources of Flake Graphite*

In 1917, Madagascar produced 35,000 tons of flake graphite, about 28,000 tons of which were exported, half to England and half to France. Of the shipments to France, about 8000 tons were reshipped to the United States. Prior to this, in 1916, some 26,000 tons had been produced in Madagascar and shipped principally to France. This left a large surplus both on the island and in France.

Comparatively little Madagascar graphite came to this country during the war. Its exportation to America was embargoed by the French government for almost the entire period of the war and, even without this embargo, it would have been practically impossible to have shipped due to vessel scarcity.

It would appear that during the

## Comments On Ceylon Plumbago Industry From British Source

THE British view of the plumbago industry in Ceylon is given in the following article published in the Board of Trade journal.

Plumbago mining is the principal industry in Ceylon and the mineral is found in various parts of the island.

Many of the mines are worked in a primitive fashion, but some employ up-to-date machinery, electric lighting, etc. The industry has suffered great vicissitudes during the war, a period of stagnation being followed at the end of 1915 by a period of prosperity and activity, which continued through 1916.

During 1917 the price of the commodity, which had been high at the beginning of the year, fell considerably, and at the end of the year there was practically no demand for plumbago. The cessation of the demand is ascribed to competition with Madagascar plumbago in England, and to a fall in the demand for the mineral from America, while Japan shipped a considerable quantity of Korean graphite, a product inferior to the Ceylon variety in carbon content, but nevertheless sufficiently good for certain purposes for which plumbago is used, and so a competitor with the Ceylon product.

The cessation of the demand for Ceylon plumbago in America was unexpected, but was probably in part at least due to accumulation of stocks purchased in previous years. Representations were made through the secretary of state, and it was pointed out that the closing down of many mines would be followed by flooding of those mines, with the result that, should a sudden demand arise, it would be difficult to meet it, as it would take some time to free the mines of water. An arrangement was made in June, 1918, by which licences to ship plumbago to the United States of America were grantable, provided the applicant had obtained a permit to import from the United States authorities. In July this arrangement was extended to Japan, but it was provided that in this case the consignee must give the British ambassador at Tokio a guarantee against re-export to Russia. There was little movement in the market, however, but towards the end of the year there were indications of a slight demand from America, when some new permits to import were issued, and a few orders began to be received.

Shipments during the first half of 1919 totalled only 4020 tons, as compared with 15,453 tons during the entire year of 1918, 27,047 tons in 1917, and over 33,000 tons in 1916.

In 1916 the United States took 75 per cent, by weight of Ceylon's plumbago and in 1917 over 81 per cent, as compared with 55 per cent in 1918 and 63 per cent for the first half of 1919.

period of the war, the United States obtained and consumed the great bulk of the production of Ceylon plumbago, while on the other hand, England and France got most of the Madagascar flake, one probably balancing the other in quantity.

The production of flake graphite in Madagascar during 1919 was extremely small, and the future of the industry on the island is problematical. Certainly the large stocks in Madagascar and in France must be absorbed before extensive production can be resumed.

The flake graphite industry in the United States got a late start during the war. During 1917 and 1918 many mines were opened and refining plants built in this country. Most of them were located in Alabama. About one-half the total tonnage came from Alabama, the remainder from New York, Pennsylvania, Texas, California and Montana.

During 1918 about 6500 tons of crystalline American graphite were produced. About 4500 tons of this was flake and the remainder was dust. While most of it was absorbed by the trade, the beginning of 1919 saw a considerable stock on hand, with most of the mills shut down and little or no demand for the product. This condition maintained through 1919 and continues today, although a slight demand has appeared and a few mills are running.

The future of graphite or plumbago in this country is uncertain. With good business conditions, there should be the same demand as there was before the war, but it is hard to say if it will be a profitable one for the American flake industry.

At the request of certain domestic producers a bill has been introduced in the house of representatives, by Congressman Hefflin of Alabama, putting a duty on foreign graphite. Such a duty would undoubtedly aid the flake producers, but would work a hardship to the crucible makers, because the bulk of their consumption is Ceylon plumbago, and they would undoubtedly continue using it in the face of even a heavy duty.

## Columbus Chosen for Next Foundrymen's Meeting

The next annual meeting of the American Foundrymen's association will be held in Columbus, O., the week of Oct. 4. Columbus was selected at a meeting of the board of directors of the Foundrymen's association, held in Cleveland, Jan. 13. Exceptional facilities for housing the exhibits are afforded by the buildings on the Ohio state exposition grounds. The technical sessions will be held in buildings adjoining those in which the exhibits are displayed, so that all the activities of the meeting will be held on the exposition grounds.

The directors carefully considered the hotel accommodations which could be provided by Columbus, as this question has always proved a difficult one in the past. From their investigations they were satisfied that Columbus would be able to meet all requirements for hotel accommodations. The week of Oct. 4 was decided upon as a time when ideal weather conditions would most likely prevail in this section.

The location of Columbus is advantageously adapted for a foundrymen's convention, being practically in the center of the iron and steel industry of the country. A radius of 500 miles takes in 22 states, and includes every city in which the convention has ever been held, with the exception of Boston. This will enable the great majority of foundrymen to reach the convention in a night's travel or less.

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The Richardson-Phenix Co., Milwaukee, has opened a new office in Birmingham, Ala. James D. Scruggs, an engineer, is in charge.

# How to Test Clay for Foundry Use

## Time of Slaking, Bonding Power, Vitrification Temperature, and Softening Point, Rather Than Chemical Analysis, Are the Factors which Determine the Adaptability of Clays for This Purpose

BY HOMER F. STALEY

CLAYS in common use in foundries all are plastic fire clays, that is, soft clays with comparatively high melting or softening, points. They may be divided into eight classes or varieties. The first division is into clays of low and high plasticity. Clays in the first division usually are sandy, slake rapidly in water and have low bonding power when wet, while those in the latter are commonly fat and sticky, contain little sand, slake slowly and have high bonding power when wet. Each of these divisions may be subdivided into vitrifying clays, that is, clays that burn hard and dense at temperatures below 1200 degrees Cent. (2200 degrees Fahr.) and nonvitrifying clays, which do not burn hard and dense until temperatures above 1200 degrees Cent. are reached. Each of these subdivisions may be divided into two classes, first, nonrefractory clays which soften at temperatures below 1550 degrees Cent. (2820 degrees Fahr.) and, second, refractory clays which soften at temperatures above that point. Each of the eight varieties of plastic fire clays shown in the foregoing classification has characteristics that render it either suitable or unfit for use in a particular service in foundry practice.

Clays are used in foundries for three purposes: As mortar in the construction of fireclay brick linings for cupolas and furnaces; as daubing material for lining ladles and the repair of cupolas; as a binder in sand mixtures in making molds for steel castings. The requirements for satisfactory service in these three uses vary, and therefore the tests to be applied to determine the suitability of clays for each of these services should vary also.

When it is realized that in the majority of cases of unsatisfactory service from fire brick construction, the failure is due not to the brick as a whole but to unserviceable mortar joints and to disintegration of the brick at the joints, the importance of careful selection of clay for this use is apparent.

In the construction of fire-brick parts of furnaces that are to be exposed to heat, the mortar joints should be kept as thin as possible. It has been found in practice that when thick mortar joints are used in furnace building the structures fail quickly at the joints. Furnaces should be, and generally are so constructed that there is no necessity for the mortar to act to any marked degree as a binding material. The function of the thin coating of clay is simply to fill small crevices between the brick. Almost any plastic fire clay will pass the test for mortar. The only essential is that it shall unite with water readily to form a thin batter which should pass readily through a 20-mesh sieve.

The effect of heat on mortar material depends on whether it has simply to withstand excessive heat or whether in addition it has to withstand the solvent action of molten metal or slag. Another factor which sometimes must be taken into consideration is the abrasive action of strong blasts of flame or moving charges of material. To meet the requirements of the first class of conditions the only essential is that the clay be highly refractory. To meet the other class of service conditions, the clay must not only be refractory but also must burn under the prevailing furnace conditions to a hard, dense mass.

For foundry work it is probably satisfactory to define the vitrification point by noting the duration of heating and temperature necessary to render a small briquette of the material so hard that it is not possible to scratch it with the blade of a good pocket knife.

### *Determining Heat Resistance*

The softening point test may be determined either by the use of pyrometric cones or by the aid of an optical pyrometer. If the cone test is used the clay should have a softening point not lower than that of cone No. 28 in order to be considered sufficiently refractory for foundry work. The method of determining softening points of clays with the use of a pyrometer, as conducted at the bureau of standards is as follows: The samples are worked up with water to a good working consistency and compressed into small cylinders. These are melted in a graphite-resistance vacuum furnace, the samples being protected from the reducing atmosphere. The melting point is taken as the temperature at which the samples are distinctly seen to flow. To be classed as refractory a clay should have a softening point not lower than 1550 degrees Cent. (2820 degrees Fahr.)

Results of tests of clays typical of the eight varieties of plastic fire clays are shown in the accompanying table. The method employed in making the slaking test will be discussed later.

Vitrifiable plastic fire clays with high softening points and ball clays are especially suited to be used as batter material where fire brick construction is to be exposed to cutting flames or to the action of slags. These clays burn to dense hard masses at comparatively low temperatures, around 1200 degrees Cent. (2200 degrees Fahr.), but do not fuse until high temperatures above 1600 degrees Cent. (2900 degrees Fahr.) is reached. They have no injurious effects on the fire clay brick in which they are in contact. For conditions in which resistance to heat is the only requirement, highly refractory, nonvitrifiable clays are available. The same kind of clay is used for the lining of ladles and in repairing cupolas. These clays are seldom used alone but nearly always are mixed with large amounts of sand. Granulated fire brick may be used instead of sand. The object of adding nonplastic material is to avoid the cracking in drying and baking that would occur with most clays if they were used alone. The tendency of these mixtures to crack may be reduced still further by the addition of about 0.5 per cent of common salt.

These mixtures should bake to hard masses, or partially vitrify, at comparatively low temperatures and should not soften until high temperatures are reached. The vitrification point of the mixture is always somewhat higher than that of the clay used. If the clay is a high grade fire clay, the addition of sand lowers its resistance to heat. The clay and sand act as fluxes toward each other. On the other hand, if the clay is of a fusible nature adding sand produces a mixture that is less fusible than the clay alone. The addition of granulated fire brick always produces mixtures that are more refractory than the clay alone.

Of course empirical service tests of the adaptability of clays for these uses can be made readily in a foundry. How-

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Abstract of paper presented at the Philadelphia convention of the American Foundrymen's association. The author, Homer F. Staley, is connected with the bureau of standards, Washington.

ever, this sort of test does not give data that can be used as the basis of specifications for the purchase of similar material. Determination of vitrification and softening points are desirable and since it is extremely difficult to make tests of mixtures in actual contact with the slag and molten metal, satisfactory results can be secured by testing the clay alone in the manner described previously.

Clay is sometimes used in the mixture for repairing the bottoms of acid open-hearth furnaces. Provided it is ground sufficiently fine to form an intimate mixture with the sand, the physical properties of the raw clay are unimportant. According to the kind of sand used and the proportions of sand and clay used in the mixture, a vitrifying or nonvitrifying fire clay should be used.

Plastic fire clays are used extensively in sand mixtures for molds for steel castings. The only function of the clay is to act as a binder. Clay for this use must be readily mixed in an intimate manner with a large proportion of sand and a small amount of water; it must have considerable bonding power when wet and it must not form mixtures that vitrify at the pouring temperature of steel.

A clay must either be finely ground or slake down rapidly to a fine powder when wet to be adapted to mixing with sand and water in the sand mixing machines in use in steel foundries. A quick slaking clay does not need to be finely ground for this class of work, but a slow slaking clay must be finely ground and thoroughly blended dry with the sand if an intimate mixture is desired in the wet composition. The slaking properties of ground clays can be determined in the following manner:

Mixtures of the clay to be tested are made with potter's flint in the proportions of 1 to 1 by weight. These are mixed with water and molded into cubes 1 inch square and dried first at atmospheric temperatures and finally at 110 degrees Cent. The cubes are then placed on a piece of ½-inch mesh wire screen and immersed in water at room temperature. The time required for the whole sample to slake and settle through the screen is taken as the time of slaking of the sample of clay. Several determinations should be made and the average taken as representative of the time of slaking of the clay.

The bonding power of clay in wet mixtures of clay and sand varies so greatly that it seems necessary for each foundry to make tests of this property on the particular mixture employed in the plant.

The bonding power of a clay in a wet sand mixture is determined in the foundry laboratory of the bureau of standards by making a shearing strength test as follows: Bars, of the mixture to be tested, 12 inches long by 1 inch square in cross section, are molded in a snap flask on a smooth glass plate. The sand is first gently rammed with the thumb and forefinger of each hand and then firmly rammed once with a round wooden bar from one end to the other. Then the flask is removed, the sand bar being left on the plate. The bar is then gently shoved lengthwise over the plate at about the rate of 1 foot a minute until it breaks off. The weight of the portion of the bar breaking off is the shearing strength per square inch of the mixture. Several determinations can be made on the same bar, and several bars should be tested in order to get a fair average.

A clay-sand mixture that vitrifies or bakes to a hard mass at steel pouring temperatures is liable to give a high sand loss and castings that are hard to clean. A thick layer of caked sand will adhere to the castings. To determine the probability of this occurring with a given mixture, vitrification tests of the clay alone cannot be used. With the small amounts of clay employed in these mixtures vitrification is brought about by the actual fusion of a mixture of clay, the finest of the sand grains, and the surface layers of the coarse sand grains. The temperature at which this takes place bears no relation to the temperature at which the clay alone vitrifies. It is more nearly, but not directly, related to the softening point of the clay. It may be said that if a clay does not soften at steel melting temperatures, it will not give vitrified clay-sand mixtures. On the other hand if it does soften at or below steel melting temperatures it will or will not give vitrified clay-sand mixtures according to the kind of sand used and proportion of clay in the mixtures.

For the foregoing reasons it is desirable to test the clay-sand mixture to be used. The mixture for the vitrification test should be heated to the temperature used in pouring steel in the foundry using the mixture. In other respects the test should be conducted as described in the section on refractory mortars.

Clays with high softening points generally are preferred for clay-sand mixtures used in making molds for steel castings. However, some clays with low melting points are used successfully. In tests conducted by the bureau on clays actually used in steel facing sand mixtures it has been found that the softening points varied from 1180 degrees Cent. (2150 degrees Fahr.), to 1600 degrees Cent. (2900 degrees Fahr.) The clays with low softening points have great bonding power and are used in such small proportions in the mixture that they do not cause vitrification.

Chemical analyses have little place in the testing of clays for foundry uses. The value of clays for these uses is dependent on the physical properties, such as ease of slaking, bonding power, vitrification behavior and softening point. The relations between these properties and chemical composition are so obscure that it is impossible to estimate them in a given clay from a study of either its ultimate chemical analysis or the so-called rational analysis.

The vitrification and softening points of a clay depend not only on its chemical composition but also on the state of chemical combination of the various elements, that is, on the kinds of minerals present, and on the size of grain of these minerals.

**Results of Tests on Eight Varieties of Fire Clay**

| Variety of plastic fire clay | Time of slaking, minutes | Vitrification temperature degrees Cent. | Softening temperature cones |
|---|---|---|---|
| Slow slaking vitrifying, refractory | 78 | 1125 | 32 |
| Slow slaking, vitrifying, nonrefractory | 117 | 1175 | 27 |
| Slow slaking, nonvitrifying, refractory | 113 | 1290 | 31 |
| Slow slaking, nonvitrifying, nonrefractory | 52 | 1290 | 27 |
| Quick slaking, vitrifying, refractory | 27 | 1200 | 32 |
| Quick slaking, vitrifying, nonrefractory | 26 | 1195 | 24 |
| Quick slaking, nonvitrifying, refractory | 6 | 1475 | 32 |
| Quick slaking, nonvitrifying, nonrefractory | 12 | 1475 | 27 |

## To Hold Training Meeting

Impetus will be given to the work of vocational training for boys and girls at a joint meeting of the National Society for Vocational Education and the Vocational Education Association of the Middle West, to be held in Chicago, Feb. 19-21.

Some of the issues to be discussed will be army training for vocational education, labor and vocational and social education, the effects of the Smith Hughes act, compulsory part-time education and vocational education in high schools.

# Making Electric Steel in Australia

## Fostered and Encouraged by Conditions Obtaining During the War, the Electric Process for Melting Steel Bids Fair to Become an Important Industry if Afforded Protection

UNTIL quite recently Australia has been almost wholly dependent upon outside sources for the supply of all the appliances needed to successfully develop her vast natural resources. Today, however, her manufacturing industries are assuming considerable proportions, especially the iron and steel business. She now is producing nearly all the steel used in the commonwealth. Among the more important producers are the Broken Hill Proprietary Co., Newcastle; G. & C. Hoskins, Ltd., Lithgow, and Australian Electric Steel, Ltd., Alexandria, Sydney. These companies are engaged in producing steel of all grades to meet the strictest specifications. The science of metallurgy has been followed and studied as closely in Australia as elsewhere and the industrial laboratory with its staff of skilled chemists and metallurgists is as much a part of the modern Australian steel mill and iron foundry as it is of the iron and steel industry of any other country.

The latest large unit added to the iron and steel industry in Australia is the Australian Electric Steel, Ltd., located at Alexandria, Sydney, New South Wales. This company formed in 1916, has already trebled its original capacity and is now producing steel at the rate of 25 tons a day. It also has under construction at West Guildford, Western Australia, an additional plant to supply the market on the west coast. The company's capital has been increased from £40,000 to £160,000. The Sydney works are employing 160 men and paying upward of £26,000 a year in wages. An interesting feature of the business is that the whole of the capital was subscribed by Australians and all of the officials and the operatives are citizens of the country. The company commenced operation in 1916 and has had, therefore, more than three years experience in the manufacture of electric steel.

Before starting operations the company made extended investigations in England and America to determine the feasibility of the electric steel for their requirements. These investigations were carried out by J. M. Deschamps, the present managing direcor, who may be regarded as the founder of the electric-steel industry in Australia.

This company was the first to introduce electric-steel melting methods into the island continent and has produced thousands of tons of high grade castings including castings for locomotives, railroads, mining and quarrying machinery and chrome steel castings with high wearing qualities. They have also made forging ingots for shafts, tools, axles and tires.

The company has government contracts in hand at the present time amounting to over £20,000. It also has large orders from the leading Australian mining companies for repair equipment and machinery, most of which was formerly imported from over seas. The company recently cast vanadium-steel locomotive frames, the first material of this kind made in Australia. Other products furnished to specifications are the high-percentage silicon steels used in electrical work, chrome-vanadium tool steel, nickel steel and special acid resisting ferroalloys for chemical works.

A well equipped laboratory is maintained by the company for the physical and chemical testing of materials. In addition to making the steel the company also undertakes the correct heat treatment of its output.

The work done by the Australian Electric Steel, Ltd., from the inception of the enterprise until the present has been carried out and rendered possible by the species of protection afforded by war conditions. Although the industry is now an established concern it is an open question whether it can survive the competition of foreign manufacture unless adequate protection be afforded it by the commonwealth parliament. All kinds of electric steel with the single exception of ordinary steel castings, which are subject to a 35 per cent duty, are now admitted free of duty under the existing tariff. The industry therefore is inadequately protected and its continued existence depends in a large measure on the future action of the commonwealth parliament.

The industry has received considerable assistance from the government, which in 1917 placed an embargo on the exportation of scrap metal from Australia. A supply of scrap is essential to the economical manufacture of steel. Scrap dealers attracted by the high prices offered in China and Japan are tempted to export to these countries. However, the government has gone on record to the effect that as long as Australian users of scrap are prepared to pay a fair price, permission will not be granted for export. The establishment of the industry in Western Australia has only been rendered possible by the large amount of scrap available.

A seven-acre site has been selected at West Guildford and arrangements have been made with the governmnt to take over all iron and steel scrap. A contract has also been entered into for the supply of electricity on a large scale from the government power house. Most of the plant is on the ground, the remainder is *en route* and it is expected to have the plant in operation in February, 1920. This plant will cater particularly to mining requirements in chrome, manganese, and special alloy steel, and it is expected that a large percentage of the work will be shipped away. The company expects to be able to meet all demands throughout the continent from its two plants on the eastern and western seaboard.

The plant at West Guildford will furnish employment for about 100 men at an annual wage bill of £20,000. The output of the works during the first year will approximate £50,000 worth of steel products. The works will be the government's chief customer for electric current as it requires £2 10s worth of current to produce a ton of steel. The company anticipates being able to obtain in Western Australia all the refractory material required for the furnaces. G. Macauly has supervision of the erection of the West Guildford works.

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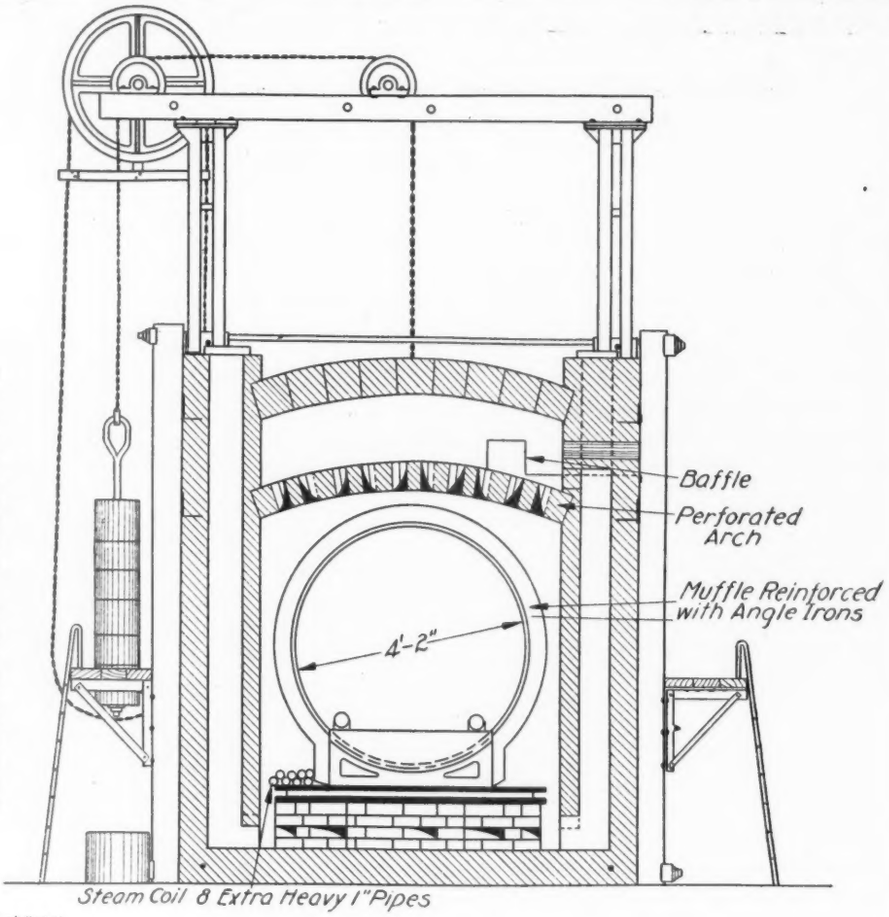
## Incorporates to Operate Automobile Foundry

A new company of which H. H. Timken of the Timken Roller Bearing Co. is an incorporator, has just received its charter for operation at Canton, O. It is known as the Motor Castings Co. and has a capital of $500,000. The new company, which will make motor parts, has acquired the plant of the Henry Miller Foundry Co., Canton. The plant will manufacture gray iron castings exclusively. A large part of the output of the new plant will be taken by the Hercules Motor Mfg. Co., of Canton.

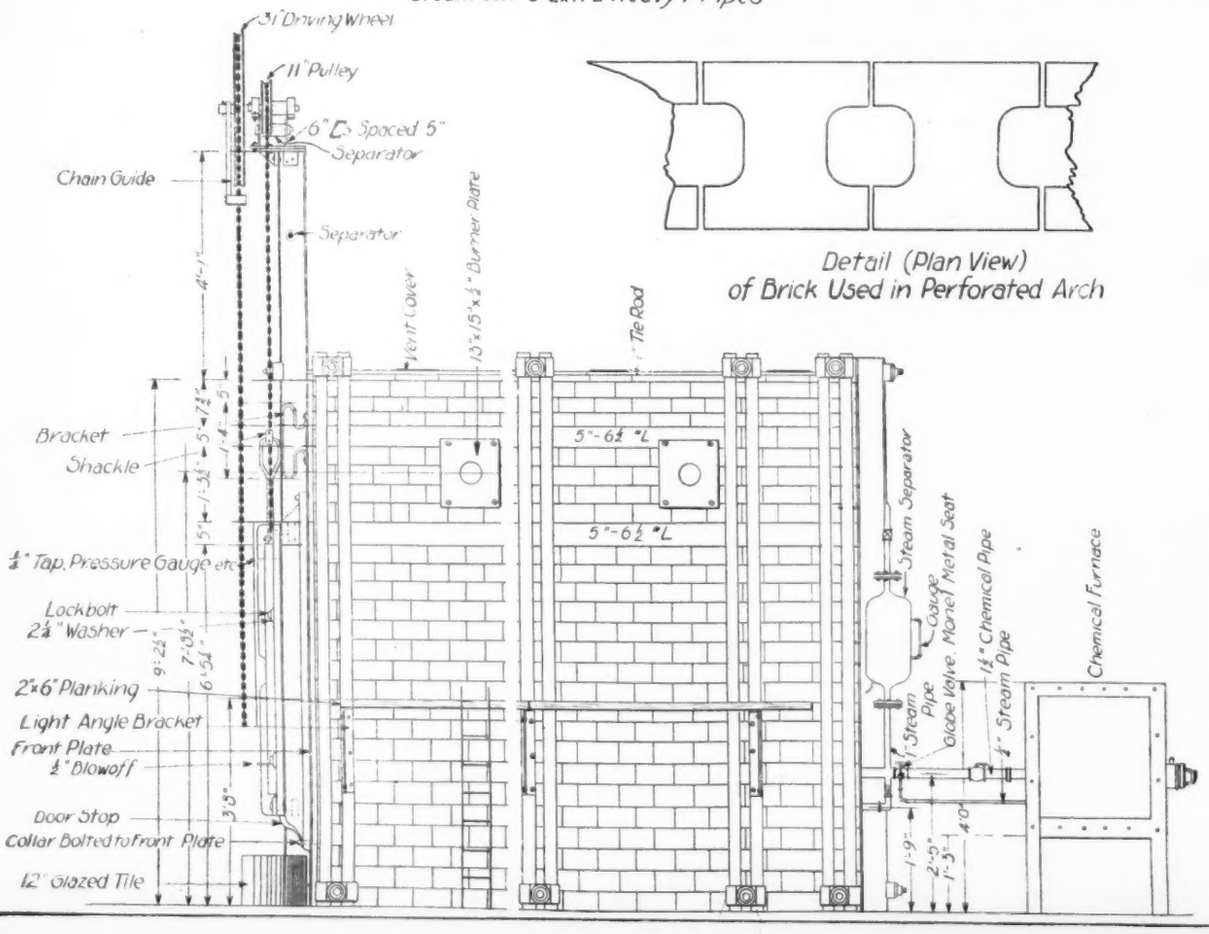
FIG. 1—AT THE RIGHT—CROSS SECTION OF THE TREATING FURNACE WITH AIR-TIGHT MUFFLE—NOTE THE ARRANGEMENT OF BAFFLES TO DEFLECT THE HEAT UPWARD FROM WHENCE IT IS REFLECTED DOWNWARD THROUGH THE PERFORATED-BRICK INNER ROOF AND THENCE AROUND THE MUFFLE TO THE OUTLET PORT ON THE SAME SIDE WITH THE BURNER

FIG. 2—BELOW—THE ARRANGEMENT OF THE TREATING FURNACE TOGETHER WITH THE SMALL AUXILIARY FURNACE IS INDICATED IN THIS ELEVATION — STRONG REINFORCEMENT AT THE SIDES IS PROVIDED BY THE ANGLE BRACES SHOWN—ONLY TWO BURNERS ARE INDICATED, BUT THREE ARE PLACED ON EACH SIDE OF THE FURNACE






Detail (Plan View) of Brick Used in Perforated Arch



# Protecting Stove Tops From Rust

## The Application of An Old Process for Imparting a Corrosion Resisting Oxide Is Put Into Operation by An Indiana Stove Manufacturer to Protect the Heating Surfaces of Stoves

CORROSION resistance is sought for a great many special hardware and machinery castings through some form of protecting coating. Protection is afforded commonly through one of three basic methods each involving a covering for the surface of the casting which is not readily acted upon by the atmosphere. Coating elements which are used commonly are oxides of iron; thin surfaces of zinc, nickel, copper or other metals; or some kind of paint.

All of these methods for applying protective covering are familiar. The Bower-Barff process involving the application of plain steam, or steam with which some hydrocarbon compound has been mixed is perhaps the oldest of the oxidizing processes and has had its development in the Swan, Bontempi, Gesner and Weiglin methods. The modern Parker process depending upon the formation of a phosphoric coating on the iron is perhaps one of the best known modern applications of chemical treatment for rendering ferrous products rust resisting.

### *Will Try It On Stoves*

Metal coating probably is most widely known through the electrolytic deposition of nickel, called nickel plating, or the application of molten zinc by galvanizing. Sherardizing is another process used to coat ferrous materials with zinc. Copper and alloys of copper are electrolytically affixed upon small iron parts, such as nails, building hardware and other ferrous products.

Painting is perhaps the most widely practiced method used for making iron objects rust resistant. The ease with which paint is applied together with the simplicity of the apparatus required has made painting popular for use on almost any object from a ship or a bridge to a porch letter box.

Recently attention has been turned to treating stoves and ranges to render them rust resistant. Nickel plating of some decorative parts has been used through several generations with the double purpose of ornamentation and rust proofing; but the periodical applications of some form of commercial *blacking* has been necessary to prevent rusting of heating surfaces. The problem of protecting the top plates of ranges during the time the stove is being assembled and until it is delivered to the user has occasioned much thought in range-making factories. To protect the stove top during the time it is standing in the warehouse, during shipment, and, when it is on display in the dealer's store, many manufacturers have had recourse to a heavy coating of grease. However, this has been objectionable through its lack of permanence and its tendency to befoul anything which comes into contact with it.

Recently the Malleable Steel Range Co., South Bend, Ind., has installed equipment for "rust-proofing" malleable-iron range tops by the Bower-Barff process, subject to certain modifications which the company states render the method more efficient for this class of work. The installation has been made by W. R. Swan, recently of the ordnance department,

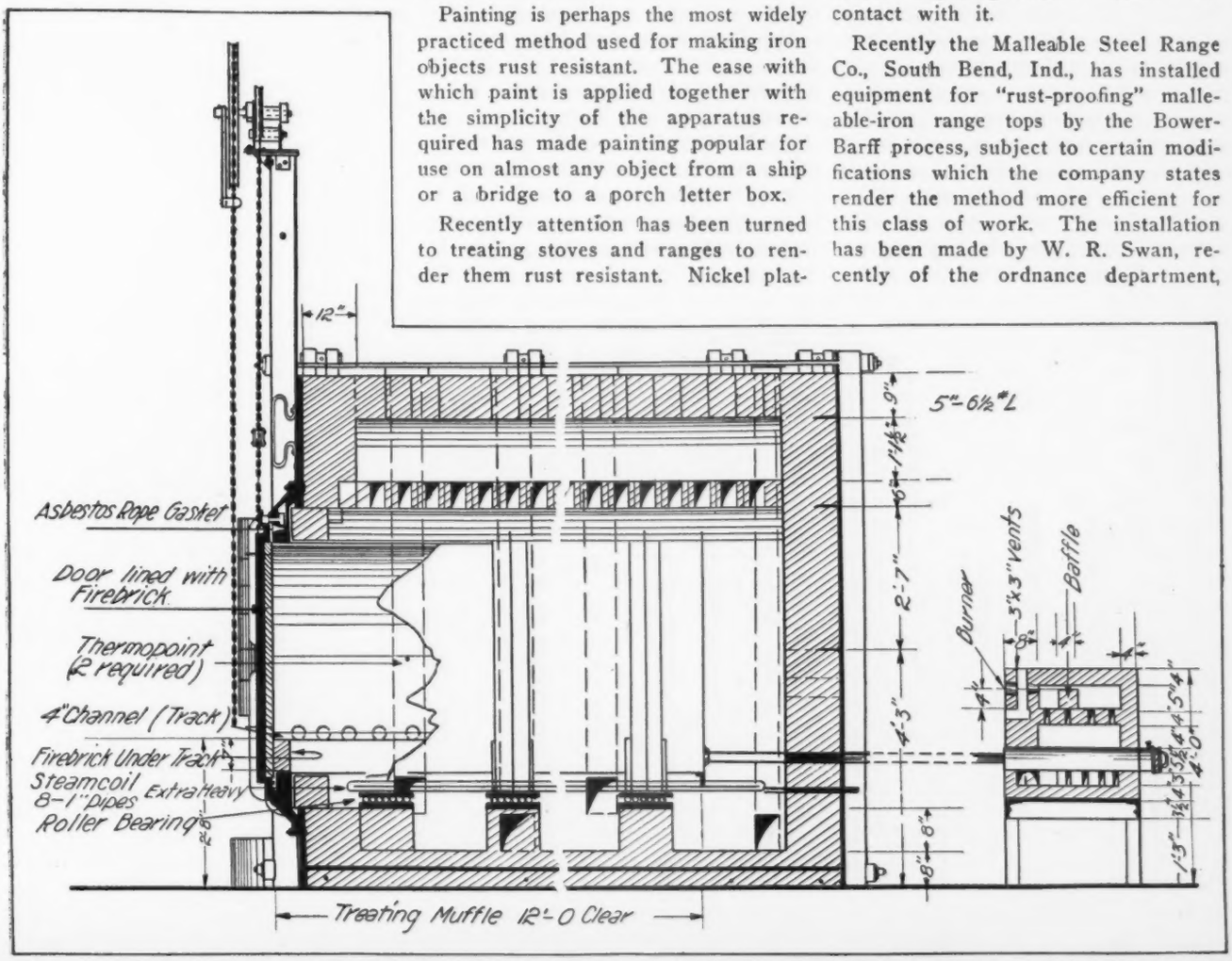



FIG. 3—LONGITUDINAL SECTION OF THE TREATING FURNACE SHOWING THE MANNER IN WHICH THE LOAD OF THE MUFFLE AND TRUCKS OF CASTINGS IS TRANSMITTED DOWNWARD UPON PIERS THROUGH EXPANSION FOOTINGS

who has experimented extensively with rust resisting treatments.

The Bower-Barff process was originated about 1876 by Professor Barff of London, who noted the resistance to corrosion of iron pipes carrying steam. He experimented by heating iron parts to about 1000 degrees Cent. (1832 degrees Fahr.) and passing steam over them, which was superheated to about 538 degrees Cent. (1003 degrees Fahr.) Professor Barff's son working in conjunction with Bower improved the process by passing steam and producer gas alternately over the heated iron parts. The steam was applied for 40 minutes and the producer gas for 20 minutes, and each was used about eight times.

In a later process the parts were enclosed in a retort and heated to 900 degrees Cent. (1652 degrees Fahr.). Then superheated steam was applied for 20 minutes giving a coating of black and red oxides of iron. After this treatment producer gas was admitted, and the process repeated until the desired thickness of oxide was obtained, after which a coating of paraffine was applied. The cost of this process in the period about 1890 was given at from $5 to $20 per ton depending upon the number of treatments applied. It was stated that the coated objects resisted the action of sea water and mild acid fumes as well as the action of moist atmosphere. However, the method was not applicable to tools nor tempered articles due to the preheating treatment.

Mr. Swan has introduced a new feature in the process which he is installing at South Bend. The range tops will be sandblasted. Then they will be preheated to about 1050 degrees Fahr. in a closed muffle. A partial vacuum will be established in the muffle, and steam superheated about 750 degrees Fahr. will be admitted under about four pounds pressure. It is stated that the vacuum condition will remove a portion of the gases incident to preheating, and will permit the steam to act freely and equally upon all parts of the castings. After about four or six hours' treatment, the castings will be removed and dipped into a mixture of linseed oil and a balsam product called *fernaline*. The action of the oil changes the dull gray to a black mat surface which proves attractive and resistant to all ordinary rusting even after the stoves have been in continuous service.

The furnace designed by Mr. Swan for this work consists of two main parts. An outer casing or shell of brick forms a circulating chamber through which heat from a number of oil burners is directed around the inner muffle or drum of boiler plates. These plates are welded together to insure joints which are airtight. A series of three brick piers serve to support the drum, and its load of castings when filled. A heavy round door, lined with firebrick may be raised to permit access to the full inner area of the drum.

The brick portion is so constructed that six transverse sections, each with its oil burner equipment, together form an oven. A section shown in Fig. 1 illustrates the mode by which heat is applied. The flame is directed into the upper portion between the upper and lower arches and strikes a baffle as shown at the right in Fig. 1. This deflects the heat upward until it strikes the curved roof from which it is deflected through the perforated lower arch down into the portion of the oven surrounding the steel muffle. Here the path of the hot gases is downward and around the underside of the muffle. After heating the muffle the gases pass out at the bottom of the chamber through one of six ports which extend up through the wall. The waste from each burner finds egress through a port on the same side on which the burner is located. The gases escape upward and out at ports at the top of the oven wall as shown in Fig. 1. The outer wall of the oven is constructed of two courses of firebrick laid in heat resisting cement furnished by the Quigley Furnace Specialties Co., New York. An insulating course of cork-filled brick is used in the upper roof and side walls. Heavy angle braces bolted together by tie-rods at the top and bottom furnish support at intervals along the wall.

Three burner plates attached on each of the two side walls, serve to support the six burners used. These burners were supplied by the Anthony Co., Long Island City, N. Y. They each consume about 1½ gallons of oil per hour. At the start all burners are lighted, but after the furnace is heated thoroughly and when additional heats are taken at intervals, three or four burners serve to maintain the desired temperature. A recording pyrometer is mounted on the wall adjacent to the furnace and two thermocouples, one at the front on one side and the other at the rear on the opposite side serve as a guide to the furnace tender. A temperature of 1050 degrees Fahr. within the muffle is required in preparing the castings for steam treatment according to Mr. Swan's present method.

The muffle, as has been stated, is constructed of boiler plate, welded so that the joints are as nearly airtight as it is possible to make them. It is reinforced by bands which encircle it at three points, and is supported at these reinforced sections upon cradles. These cradles in turn are carried upon plates which rest upon roller bearings set to permit longitudinal motion as the muffle expands under heat. The roller bearings operated upon plates which cap brick piers running down to the foundations of the furnace. A trackway within the muffle is supported by sector frames which rest upon the bottom of the drum directly over the main reinforced sections supported by the piers. Thus the load of castings at no time brings a cross-bending stress upon any section of the muffle, but the entire weight is transmitted directly to the piers as is shown in Fig. 3. Steam is admitted to the muffle through a pipe at the rear, which is fitted with a slip-joint within the back wall of the oven, so that expansion is compensated.

Although only two trackways are shown in Fig. 1, three are provided, as three-wheeled steering trucks will be employed to deliver the castings to the treating furnace. One 72-inch and one 36-inch truck together holding 30 castings will be used. Short removable connecting tracks will be used to carry the trucks from the floor to the rails within the muffle, which are on the same level with the floor tracks.

A simple operating mechanism, details of which are shown in Figs. 1 and 2 is used to raise and lower the heavy, circular, firebrick lined door. When the door between its guides drops into place it is firmly clamped against the end of the muffle by a series of lock nuts. An asbestos gasket guarantees an air-tight fit.

At the rear of the furnace is an auxiliary furnace used to superheat steam which is delivered through a pipe line from the plant boiler. This furnace also may be used to gasify any chemical substance which might be desirable in future rust proofing practice. At the present steam, superheated to 750 degrees Fahr. is used.

In operation, the trucks loaded with range tops are rolled into the muffle and the door closed. The oil burners then are fired and the heat continued until the pyrometers show the required heat of 1050 degrees Fahr. A water-actuated syphon system connected to the steam inlet

pipe of the muffle then is set in operation until a vacuum of about 5 inches is established. Then the connecting valve to the syphon system is closed and superheated steam under about 4 or 5 pounds pressure is admitted to the muffle. The castings are left in the steam for a few hours. Then they are withdrawn and dipped as has been described.

Mr. Swan, who has operated a similar system previously states that a manifold was treated for the Cadillac Motor Car Co., Detroit. This manifold was in continuous use for 12,218 miles, and was wetted frequently with a damp cloth in an endeavor to cause it to corrode but no corrosion was manifested. A test which seems to offer satisfactory evidence of the efficiency of the process.

# How and Why in Brass Founding

**By Charles Vickers**

## Plumbago Wash Protects Cores

*We are having trouble with the cores used in brass heater castings for furnaces. These cores are furnished us and are made of a very coarse mixture of sand. The metal appears to eat into the cores for we find on breaking defective castings that the bottom of the ring or jacket core is all impregnated with metal as much as an inch deep. Can you suggest a wash for the cores that the metal will not penetrate.*

The cores should be protected by a wash of plumbago, painted on with a soft brush and then dried. Use silver lead and make the wash by mixing the lead with molasses water until a mixture of the consistency of cream results. Add sufficient molasses to the water until the latter looks like strong tea, then scatter in the silver lead and stir thoroughly. Paint this mixture on the cores while they are hot and the wash will dry very quickly. It is advisable in cases where the thickness of metal is considerable to give the cores two coats. The first coat should be made thin so it will penetrate the core and a creamy wash should be brushed on top of this. If properly coated with plumbago, the metal will never find its way into the body of the cores.

## Nickel Silver Castings

*We would appreciate any information you are able to give us regarding the melting and molding of nickel silver castings, also how to eliminate pin holes.*

The correct way to melt nickel silver is to bring it up to the right temperature as rapidly as possible, then to pour immediately. The alloy must never be allowed to soak in the fire if pinholes are to be avoided, and trouble results when the melting is done too slowly. The molds are made the same as for brass. They should be well vented either by a backing of open sand or by vent wires, and "smoke vents" should be scratched from the mold cavity to the edges of the flask at the mold joint. This is the practice with regard to yellow brass and as nickel silver contains considerable zinc the same methods govern. Nickel silver is difficult to cast as it is a brass with a portion of the copper replaced by nickel which raises its melting point and makes it more sluggish even than yellow brass, but a molder experienced with the latter metal will be able to handle the nickel silver without difficulty. It must be poured the same as yellow brass, namely, with decision, the sprue being kept filled, and if the castings are not intended to hold air or water pressures, a little aluminum will greatly facilitate casting the alloy. About 2 ounces to the 100 pounds of nickel silver should be used, and in pouring this treated metal, the temperature should be such that only a little smoke arises from the metal.

## An Alloy Recommended for Kitchenware

*We would like to obtain the formula for an aluminum alloy suitable for producing cast kitchenware such as skillets, tea kettles and so forth.*

A dependable alloy consists of aluminum, 92 per cent, and copper, 8 per cent. This alloy can be purchased already made. It also can be made readily by melting the correct proportions of virgin aluminum and copper in the form of thin strips, or by the addition of an alloy consisting of 50 per cent copper and 50 per cent aluminum to the proper amount of virgin aluminum. The ratio is 16 per cent hardener to 84 per cent aluminum. When the copper is added as sheet copper, a portion of the aluminum is melted and is brought to a cherry red heat. Then the copper is dissolved in it and the balance of the aluminum is added with vigorous stirring and then poured.

## Melting Aluminum Chips

*Will you please state the most satisfactory method of melting aluminum chips and scrap? What is the best flux to use?*

When melting aluminum chips and scrap of a finely divided character on a large scale, the flux used most extensively is common salt. For crucible melting the method practiced by H. W. Gillett as described in a paper before the Institute of Metals at the Atlantic City meeting in 1915 is to mix the chips with a large amount of flux consisting of a mixture of 85 per cent common salt and 15 per cent fluor spar before charging them into the cupola. The fluor spar was powdered. From 20 to 50 per cent of the weight of the chips is the amount of flux used. The cleaner the chips, the smaller the amount of flux required. The mixture of chips and flux is charged into crucibles and melted, and as they sink down under the heat, more of the flux and chips mixture is packed in until the pots are filled with liquid metal.

The pot is then left to stand in the furnace until the flux is fully liquid, when the globules of aluminum settle to the bottom. This requires a temperature of about 1650 degrees Fahr.

## Cheap Aluminum Alloy Does Not Pay

*We have had considerable trouble from drawing of the metal when casting aluminum pattern plates. These castings are ⅜ inch thick, and are 13 x 13 inches and 14 x 20 inches in section, respectively. A peculiar thing is that in some of the heavier plates there is no draw, while on the light castings it is quite marked. We use a cope 7 inches deep, and build up the runners 3½ inches higher. A large wedge-shaped riser is placed in the center of the plate and is carried up the full 10½ inches*

*through the cope. The plates are poured from two sides, and each sprue connects with a runner having three entry gates, equally distributed. Should the gates be cut wide and deep, or wide and thin? Is it necessary to put risers on aluminum? Should aluminum be melted under a cover of charcoal? The alloy is supposed to be No. 12, but zinc smoke is noted on melting it. Will zinc in the alloy increase the tendency to draw? When the plates are removed from the sand they show crystals like galvanized iron. Would any other metal than zinc cause this peculiarity?*

The various troubles enumerated arise from the use of aluminum which, although sold for No. 12, consists of a heterogenous mixture of all sorts of aluminum alloys. The price of this metal may be under that of good, reliable aluminum, but it will cost much more in the end, owing to the trouble and loss experienced in getting castings free from defects. With a 10½-inch cope and heavy sprues, these plates should not require the wedge-shaped riser mentioned, although this riser does no harm provided it can be removed without leaving scars. When the feeding is done with a riser the gates should be wide and thin. If the riser is left off the gates should be made deeper to allow for feeding. Aluminum should not be melted under a cover of charcoal; keep down the temperature and flux with zinc chloride just previous to pouring. An aluminum-zinc alloy is more difficult to cast in sand than an aluminum-copper alloy. No. 12 aluminum should not show the crystals described. It would be well to have the aluminum analyzed.

## Electro-Plating Aluminum

*We would like to learn if there is any method of electroplating aluminum with nickel, and if there is, how it is done.*

There appears to be little difficulty in getting deposits of metals by electroplating, on aluminum. The difficulty is in getting them to adhere. This suggests that the cleaning of the articles is the most important part of the process, and there are any number of methods of attaining this result. Some consider sand blasting the best method of cleaning because it produces a roughened surface to which the nickel can cling. A French method is to immerse the aluminum in tepid water, then wash in water containing 2 per cent potassium cyanide, after which the articles are immersed for a few seconds in a solution of hydrochloric acid, 1 gallon, water, 1 gallon, and chloride of iron, ¼-ounce. After this immersion the articles are transferred to clean water and washed. They are then placed in the plating solution. After being plated they are washed in boiling water and dried.

A German method uses a solution of water, 1 gallon; potassium cyanide, 8 ounces; ammonia, 4 ounces for cleaning the aluminum. The bath is heated to boiling, the articles are immersed for about 15 seconds, then are transferred to a solution of water, 1 gallon, cream of tartar, 4 ounces. This cleaning process is repeated, when the articles are transferred to the regular plating bath.

## Chandeliers Are Difficult to Cast

*We are making castings of yellow brass for electric fixtures but we experience great difficulty in getting the mixture to run, and have found it necessary to add a percentage of copper and tin to make the metal flow easily. This increases the cost to a point where we stand to lose money on the order, and we would feel favored if you could inform us of anything that could be added to a yellow scrap mixture to make it flow. The work is gated and weighs from 3 ounces up per casting.*

Castings for chandeliers and electroliers are usually made from an alloy of copper and zinc known as *dipping brass.* This alloy is variable in content of zinc, and may contain lead and tin, singly or together in variable quantity. On alloys with 70 per cent copper, and 30 per cent zinc, it is often used as it dips well. A cheaper alloy contains: Copper, 60 per cent; zinc, 37 per cent; lead, 3 per cent. A better running but more expensive alloy is the following: Copper, 75 per cent; zinc, 23 per cent; tin, 1 per cent; lead, 1 per cent. The difficulty in the present case is not due to the use of a yellow metal, but to unskillful handling of it. As the castings are ready gated, there is a possibility the gates are not suitable for running castings of the thinness demanded by the trade. This should be looked into, as it is a very common mistake. In making light castings for chandelier work, the gates should be attached to the back of the castings, many small gates being used. As the back of the castings is in the cope, the gates are cut in that section of the mold. The runner to each casting should be circular. A piece of stiff wire bent to fit usually makes a good runner. The molds should be sprayed with molasses water and left open until nearly ready to pour. Then they should be skin-dried by a torch, until the flour, with which they are coated, is a nice brown color.

It is important to have the top and the bottom boards of the molds well bedded. The boards must not rest entirely on the sand of the mold, otherwise they will be liable to crush off the thickness of the casting and prevent it from running. A careful molder is required to make such molds, or else careful planning must have so prepared the patterns, gates and manner of making molds, that the methods employed are foolproof. Pouring the metal also calls for more than ordinary skill. The lip of the pot must be rested on the flask, and the vessel given a quick, decisive dip, filling up the mold instantly; otherwise the percentage of loss will be ruinous. So much cleverness is required to produce chandelier castings that such work is usually left to the specialists. In the present case if the workers are not used to this class of work, and especially to handling yellow brass, the best way will be to use a yellow metal containing aluminum. Such a metal will run quite easily. A good way of adding the aluminum is to first make an alloy of 95 per cent zinc, and 5 per cent aluminum. Add just sufficient of this alloy to give the desired fluidity. Commence with the addition of 0.5 per cent of the alloy, and if this is not sufficient gradually increase the amount. The aluminum will give the castings the appearance of manganese bronze, but if they are to be dipped, this will not greatly matter.

## Two Kinds of Benedict Nickel

*We would like information relative to an alloy known as benedict metal. What is its composition?*

There are two alloys known as benedict nickel. They differ in the nickel content. One alloy is composed of copper, 85 per cent; nickel, 15 per cent. The other has copper, 80 per cent; nickel, 20 per cent. These alloys are used for condenser tubing and for plumbing fittings because they approximately match the nickel coating and do not show a great contrast after the latter wears off.

These alloys also may be rolled and drawn. In casting the ingots for rolling it is the practice to add a little manganese copper, under 0.25 per cent, as a deoxidizer. A combination of magnesium and manganese is the best deoxidizer to use in metal for sand castings.

Another alloy and one that is recommended is copper 64 per cent, nickel 33 per cent and aluminum 3 per cent. A higher temperature than usual is needed to melt this alloy.

# Metallurgy of Manganese Bronze

## Strength and Ductility Are Controlled by the Composition of the Alloy Based on the Zinc Equivalent of Each Used—Microscope Reveals Percentage of Alpha and Beta Solid Solutions

BY ERNEST J. DAVIS

ENGINEERING work where corrosion offers a serious consideration, has created a large demand for a non-ferrous metal which is highly resistant to corrosion and at the same time can be used as a substitute for steel without materially decreasing the strength or increasing the weight of the various parts. Many compositions of alloys from time to time have been proposed and have been used with excellent results to obtain the combination of desired properties. But at the present time probably the most widely used alloy is the one generally known as manganese bronze. Although this so-called bronze is a favored alloy, its manufacture and best composition have been submitted to considerable discussion, and this has prompted the writer to give his experience with the manufacture of the alloy. This so-called manganese bronze is nothing more than a high brass to which small percentages of aluminum, manganese, iron and tin have been added by the proper method of alloying. These additions have been made with the definite purpose of strengthening the alloy and rendering it more dense and close grained than the ordinary yellow brass.

We say the so-called manganese bronze, because although manganese bronze is the name by which the alloy is best known, this nomenclature is incorrect. As a bronze is essentially an alloy of copper and tin, and as there is only a small percentage of tin in manganese bronze we cannot properly apply the name bronze to this alloy. According to the nomenclature proposed by the English Institute of Metals, this alloy should be called *manganese-aluminum-iron, etc., brass,* but as this name is rather long it has been decided to call the alloy *manganese brass.*

The composition of manganese brass varies over wide limits as follows:

| | Per cent |
|---|---|
| Copper | 50–60 |
| Zinc | 30–45 |
| Iron | remains steady about 1.0 |
| Manganese and aluminum | traces—4 |
| Tin | 0.5–1.25 |
| Lead | depends upon purity of spelter used. |

This wide variation of composition has led some manufacturers to believe that manganese brass can be made from any low-grade scrap they may come across, while other manufacturers claim that only virgin metals can be used with any success. According to our experience, manganese brass can be and is made from scrap, with results to equal those obtained with virgin metals. But the scrap must be carefully selected and refined before it is used in the mixture for the alloy. Special attention must be paid to see that it is free from arsenic and antimony, or disappointing results will be obtained.

The crucible furnace is employed to make manganese brass in small quantities from virgin metals. The type most used is the coke-fired pit furnace of square section. The furnace consists of a square rectangular chamber built of firebrick. Its top is level with the floor. The bottom is closed with grate bars and connected to an ash pit. The furnaces are built in batteries of six or eight and connected by flues to a single stack. The square-section pit furnace is the most efficient type of coke-fired pit furnace, although its efficiency at the best is very low. This type of furnace is gradually being replaced by coke-fired tilting furnaces and gas-fired furnaces, on account of the increased efficiency, higher temperature, ease of control and quicker melting obtained with the latter types.

### *Sheet Iron Chips Added*

There are a number of ways of adding manganese and iron to manganese brass. The manganese may be added as ferromanganese, containing 80 per cent manganese or, better still, as an alloy of copper and manganese which contains 30 per cent of manganese and has a much lower melting point than does ferromanganese. If the latter is used it is necessary to add a certain amount of iron because 80 per cent of the addition is manganese and it does not contain sufficient iron for the manganese brass. The remainder of the iron is added as sheet iron chips. As both the ferromanganese and the sheet iron have high melting points some manufacturers have considerable difficulty in getting these metals to dissolve in the molten copper without undue loss of iron and manganese by oxidation. On this account an alloy of copper, iron and manganese which has a lower melting point and is more readily used in the manufacture of manganese brass than either sheet steel or ferromanganese, has been prepared. In charging the graphite crucible, a layer of charcoal which has been broken into fine lumps, is placed on the bottom. Then, if the manganese is to be added as ferro, the required amount is put into the crucible in the form of pieces about an inch square. The steel chips are next added with as much copper as the crucible will hold. Finally the charge is covered with charcoal and the whole is melted as quickly as possible. It has been suggested that the ferromanganese be crushed finer to facilitate melting, but this only results in a greater loss of manganese as the fine particles of ferromanganese float to the top when the copper melts and are rapidly oxidized.

The introduction of iron into the alloy as sheet iron, is not such a difficult proposition as is generally supposed, because it is not necessary to superheat the copper to the melting point of the mild steel. This is because molten copper readily absorbs or dissolves small quantities of iron at a temperature not far above the melting point of copper. But the alloy of copper, manganese and iron is better to use for those who have had little experience with manganese brass. It is charged in the same way as described for ferromanganese, with the necessary copper to make up the weight required. When the whole is melted the necessary amounts of aluminum and tin are added and stirred in well. Finally the spelter is added carefully and the whole well stirred. A small test bar should then be cast in a chill mold. This sample bar is quenched in water and fractured. On comparison of this bar with a standard fracture it is possible to judge whether sufficient zinc has been added. If there is not enough zinc in the alloy more is again added. This procedure is kept up until there is sufficient zinc in the alloy. A sample bar is taken after each small addition of zinc. These bars are compared with the standard un-

til one matches with it. The metal is then skimmed and poured into ingot molds, or a number of crucibles are poured into a small ladle and cast direct. However, it is better to cast into ingots first and then remelt.

The appearance of a fracture of manganese brass is quite characteristic. With a low percentage of zinc a yellowish fiberous fracture is shown. As the zinc is increased the color changes from a yellow to a pinkish tinge and the fracture becomes partly fiberous and partly crystalline. A large proportion of zinc gives a completely crystalline fracture. By estimating the proportion of crystalline area or sparkle, as it is called in the foundry, to the fiberous, we have a means of controlling the quantity of zinc in our alloy and indirectly its mechanical properties. For quantities larger than a ton a reverberatory furnace is used. Generally the alloy is first made in a crucible furnace and then remelted and cast from a reverberatory furnace.

In the manufacture of manganese brass a pyrometer should always be used so that the temperature may be kept as low as possible. This will help to control the composition of the alloy by cutting down the loss of zinc which volatalizes more readily at higher temperatures. As manganese brass melts at 1000 degrees Cent., or less, it is not necessary to have a pyrometer with a rare-metal thermocouple, and there are some good base-metal thermocouples which would be satisfactory on the market.

Although there has been considerable discussion as to whether it is best to use virgin metals or to incorporate scrap in the charge for manufacturing manganese brass, scrap is used to a considerable extent. But care must be taken in the preparation of the scrap. Heads, runners, scrap castings, etc., are used without any preparation. Sweeping, skimmings, ashes, etc., must be carefully washed and separated from dross and dirt. They are melted down into ingots and after carefully ascertaining the composition of the resulting ingots they may be used in the charge. Manganese brass can be manufactured from scrap in the crucible furnace quite as readily as in the reverberatory furnace, although some foundrymen tell us that it is impossible to accomplish satisfactorily in crucibles.

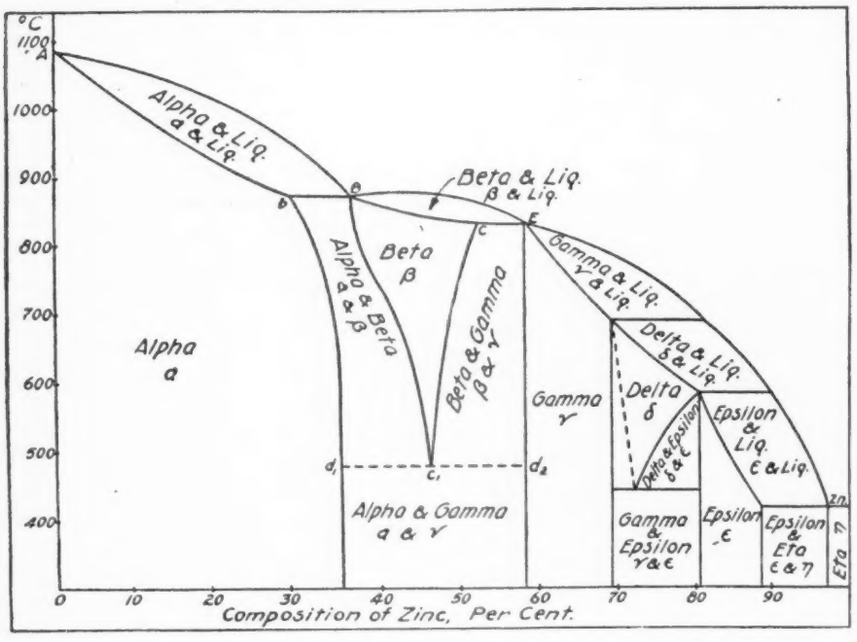



FIG. 1—EQUILIBRIUM DIAGRAM OF COPPER-ZINC ALLOYS, BY SHEPARD

The composition of the alloy and its internal structure will be considered before proceeding to describe the manufacture of manganese brass from a scrap charge. As we already have mentioned, manganese brass is nothing but a yellow brass to which such elements as aluminum manganese iron, etc., have been added with the definite purpose of strengthening the alloy. Now these elements have another effect upon the alloy. Besides increasing the strength, each of the elements has the power to replace a certain quantity of zinc and thus give the alloy the properties of one containing more zinc. Fig. 1 shows the equilibrium diagram for the copper-zinc alloys. Here it may be seen that alloys containing up to 36.5 per cent zinc consist of a single solid solution while above this percentage of zinc to 46.5 per cent zinc we have a duplex structure, consisting of two solid solutions. Again above 46.5 per cent of zinc there is a single solid solution. The first solid solution is called alpha. Fig. 2 is a micrograph of a manganese brass consisting completely of this alpha phase. The second solid solution is called beta. Fig. 3 is a micrograph of a beta manganese brass.

Now to make it clear what happens, apart from any strengthening or cleaning action, when a metal is added to the alloy, the following example is given. Referring to Fig. 1 it may be seen that an alloy of 65 per cent of copper and 35 per cent of zinc should consist wholly of the alpha solid solution. Now replace 1 per cent of copper by 1 per cent of aluminum and the alloy will be found on examination to have a very different structure. There is no longer a single alpha solid solution but there is a duplex structure containing both the alpha and beta solid solutions. Fig. 4 is a micrograph of an alpha + beta manganese brass. If the alloy is examined it will be found that it consists of 35 per cent of the first solid solution, alpha, and has per cent of the second, beta, and has the appearance and properties of an alloy containing 39 per cent zinc instead of 35 per cent zinc. Each of the added elements, aluminum, manganese, iron, tin and lead, produces the same effect, i. e., they replace a certain amount of zinc. This amount has been estimated by means of the microscope and a number has been assigned to each of these elements. These numbers are used in calculating a charge of scrap or virgin metal for the manufacture of manganese brass as will be shown. Below are given the multiplying numbers:

| | |
|---|---|
| Aluminum | 6.0 |
| Manganese | 0.5 |
| Iron | 0.9 |
| Tin | 2.0 |
| Lead | 1.0 |

The zinc equivalent of an alloy is obtained as follows: Suppose the alloy contains copper, 61.5 per cent, zinc, 36.09 per cent; manganese, 0.28 per cent, aluminum, 0.38 per cent; iron, 1.0 per cent and 0.75 per cent tin, which is the composition of a typical manganese brass. To obtain the zinc equivalent of this alloy the figures just given are used as follows:

| | | |
|---|---|---|
| Aluminum | 0.36 x 6 | = 2.16 |
| Manganese | 0.28 x 0.5 | = 0.14 |
| Iron | 1.0 x 0.9 | = 0.90 |
| Tin | 0.75 x 2 | = 1.50 |

These results are added together and then to the zinc percentage as shown: 2.16 + 0.14 + 0.90 + 1.50 + 36.09 = 40.79. To this figure the copper figure is added which is 40.79 + 61.50

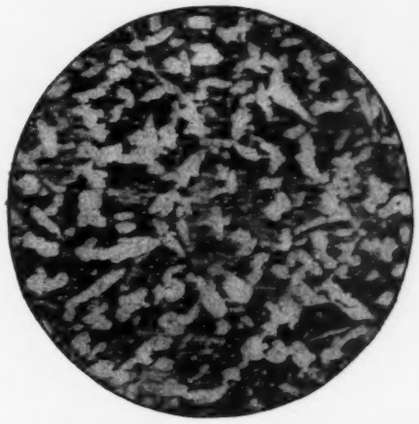


FIG. 2—COPPER-ZINC ALLOY WITH 50 PER CENT ALPHA; MAGNIFIED 100 DIAMETERS—ALPHA WHITE

= 102.29. This result is then divided into the apparent zinc figure and gives:

$$\frac{40.79}{102.29} = 39.88 \text{ per cent}$$

The product is the zinc equivalent of the alloy, and an alloy of this composition would contain about 66 per cent alpha and 34 per cent beta solid solution. It is found that the properties of these two solid solutions which occur in manganese brass are exactly opposite to one another. The alpha solid solution is soft and ductile, with comparatively low tensile strength but with high elongation; while the beta solid solution is soft with a high tensile strength and a rather low elongation. Now by varying the proportions of these two solid solutions present in the alloy it is possible to obtain a range of tensile strength from about 45,000 pounds per square inch to about 95,000 pounds per square inch, and an elongation from 70 per cent to 10 per cent or less.

In the manufacture of manganese brass from either scrap or virgin metals advantage is taken of this range of strength and the charge is calculated to a certain zinc equivalent or alpha-beta ratio. If a manganese brass of 66,000 pounds per square inch tensile strength with 20 per cent of elongation is required, the alloys would be worked to about 25 per cent alpha or 44 per cent zinc equivalent. Or, if a metal having 88,000 pounds per square inch tensile strength is required, it is necessary to exclude the alpha solid solution and keep the alloy in the beta range.

In working with an all-scrap charge the composition of the metal should be obtained by chemical analysis. After the composition of the charge is known the zinc equivalents can be calculated. However, should a microscope be available, it is only necessary to determine chemically the elements other than copper and zinc, and the zinc equivalent then can be obtained from a microscopic examination by estimating the amount of alpha present and from the following formula:

$$Zn = \frac{465 - a}{10}$$

where Zn = zinc equivalent, and a = per cent of alpha present.

A charge can then be calculated to equal a zinc equivalent according to the strength required and the composition brought to this standard by means of correctives. The amount of spelter to add to the charge is controlled by sample bars in the same way as in the manufacture of the alloy from virgin metals. However, when a manganese brass is required with a low tensile strength, say 65,000 pounds per square inch, and 30 per cent or more elongation, it is not possible to control the spelter addition by means of sample bars, because the fracture of an alloy giving the above strength is fiberous and contains no sparkle. In such a case a rapid examination of a section from a sample bar is made under the microscope and the necessary zinc addition is calculated by comparison with the standard bar. In making a manganese brass of a tensile strength of 90,000 pounds per square inch and over, it is not advisable to raise the zinc to bring up the alloy into the beta condition. The same effect is obtained by raising the aluminum and manganese to 2 per cent or more. It is also advisable to keep the high-manganese brass free from tin, as with more than traces of tin these alloys become exceedingly brittle and difficult to handle.

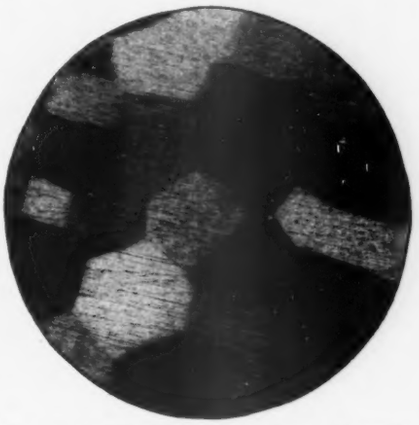


FIG. 3—COPPER-ZINC BETA SOLID SOLUTION; MAGNIFIED 100 DIAMETERS

Although the manufacture of manganese brass is full of difficulties, with the help of science these troubles are gradually being overcome and with proper scientific control in the works, there should be no real hinderance to making manganese brass.

## Crane and Hoist Employes Go to Night School

With the ultimate object of training its own employes to fit them for higher positions the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., maintains a technical night school. Members of the organization who were regarded as specialists in their particular lines of work and who also by experience and education were considered particularly qualified to teach, were selected to conduct the classes.

The school was opened in the fall of 1916 and the following May certificates were presented to 55 students who had completed the full course. The next year in spite of war conditions 57 certificates were granted and for the year just passed, 98 students were enrolled.

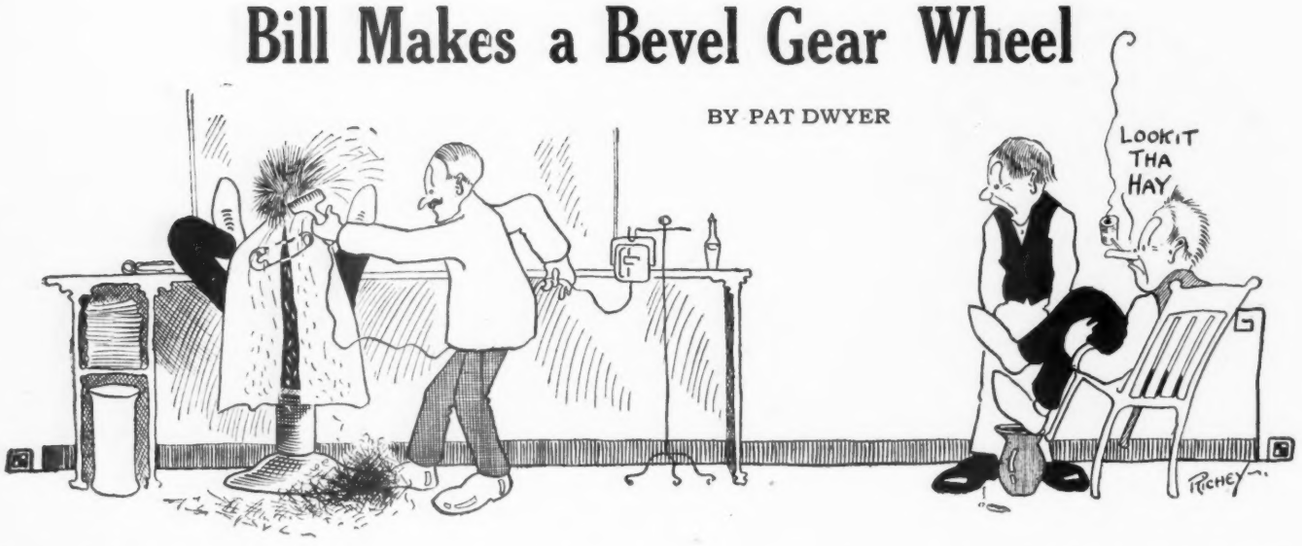
The aim of the school is to provide instructions of such a nature that practically any employe who desires to increase his or her knowledge may pursue subjects which will benefit them. The training given in nearly all the courses is designed to be general rather than specific. This enables the students to make themselves more skillful in their particular branches of work by applying the fundamental principles, underlying all engineering and shop work, to their daily task. The facts which they learn in the class at night may often be applied to their work in the shop the next day, and thus become of immediate use.

The course of studies includes machine shop practice, blueprint reading, mechanical drawing, shop mathematics, shop mechanics, machine design, practical electricity, typewriting and office training.

FIG. 4—COPPER-ZINC ALLOY WITH 35 PER CENT ALPHA; MAGNIFIED 100 DIAMETERS; ALPHA WHITE

# Bill Makes a Bevel Gear Wheel

BY PAT DWYER



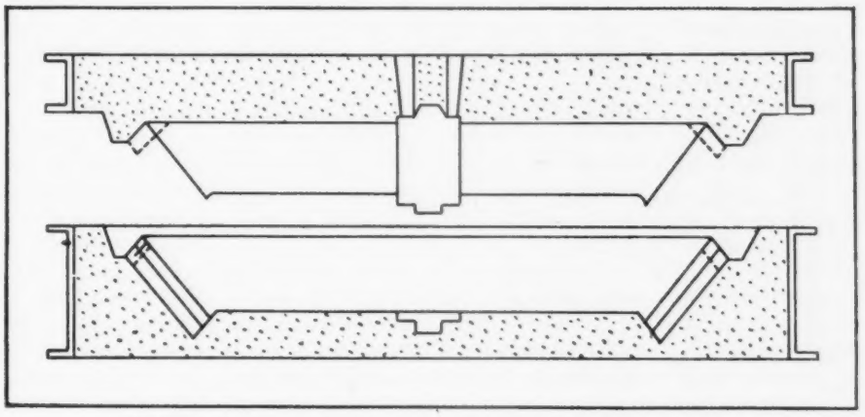

WHEN in the course of human events it becomes necessary for me to fare forth on some Thursday night in the dark of the moon to have my flowing locks trimmed by the barber I repair to a modest establishment a short walk away from the ancestral home. The last time I went in there I found Bill sitting in a chair tipped against the wall and smoking a villainous smelling corn cob pipe. I ranged up and dropped anchor alongside him and asked him what was the good word. He removed the pipe from his mouth and with the stem for a pointer indicated the citizen in the operating chair and shook his head solemnly. "Just look at the hair cut that bird is getting," said he. "I could give a fellow a better hair cut with a knife and fork." I asked him what he saw wrong with it. "Oh, there is nothing wrong with it," said he. "If you were to take that fellow outside, tie a nice little blue bow around his neck, drop him on all fours and strap a cute little blanket around him and spray a little perfume on his dear little muzzle you couldn't tell him from any other Pomeranian." I said that it was not the barber's fault, fashions in hair cuts change and the barber must cut the hair to suit the customer, "and anyway," I said, "all the queer cutting is not confined to the barber shops; just consider the proposition the molder is often up against, of changing the length of the teeth on a gear wheel. It is a familiar process in all shops where gears are made to any extent. The same pattern frequently is used to make gears of widely varying face dimensions. It is a rather interesting piece of work to increase or decrease the face of a spur wheel, and requires a considerable degree of skill on the part of the molder, but I suppose you are aware of that already."

"During my young and palmy days," said Bill, "when the day's work sat lightly on my mind and my chief concern was how to distribute my time in the evenings to the best advantage in the company of other hare brained and congenial spirits; when six months was the maximum time I could afford to spend in any one town I spent a season in a foundry in New England. The chief mogul at this foundry in those days was a 'lad of pairts,' as they say in the country from which he came. I learned more from him than from any man I ever worked for. In fact, I appreciated his instruction so much that I overstayed my usual time and remained with him for 14 months. However, I have no intention of indulging in a panegyric but the few remarks I have made are germain to the subject since I saw more and helped to make more gears in that shop than in any other which I have favored with my company. I became fairly proficient, but of course never approached the lofty plane occupied by the old hands in the shop who had been making gears since before I was born.

"OH BOY, THEM WAS THE DAYS WHEN LIFE WAS A DREAM"

"Making the face of a spur gear or pinion wider or narrower possesses several features of interest, but I have made a 56-inch diameter bevel gear with a 6-inch face off a 60-inch diameter pattern having an 8-inch face, and as that kind of a job is a little off the beaten path I'll tell you about it. The pattern was in two pieces, the arms and hubs forming one part, and the rim and teeth the other. A bottom board was leveled on the floor and a 72-inch round drag set on it. The rim part of the pattern was laid on the board and centered, bricks and wedges being slipped under the high edge at several points to pre-

vent the pattern from springing during ramming. Heap sand was piled inside and outside the pattern to conserve facing sand. Later when the drag was rolled over it was removed in making the parting. Facing sand composed of half and half new and old sand and carrying sea coal in the proportion of one to eight was sifted through a No. 8 riddle over the teeth. Three 3-inch wire nails were dipped into thin paste and set upright in each tooth. The inside nails were kept back about an inch from the roots of the teeth while the outside nails were kept back about 2½ inches from the points so that they would be sure to clear when the necessary two inches would be cut off the ends of the sand teeth later on. A quantity of facing sand was then thrown into the teeth, one handful at a time, until they were completely covered to the depth of about an inch. The mold was then filled with heap sand, rammed successively in courses of about 6 inches. It was then struck off flush with the top flange of the flask, after which a half inch thickness of soft sand was spread over it and a bottom board rubbed down to a bearing. The bottom board was removed and a series of diamond-shaped indentations were made in the exposed sand with a straight edge held at an angle and brought down smartly at intervals of about three inches. It was then gone over thoroughly with a vent wire, care being taken to see that the vent wire did not come into actual contact with the pattern. The bottom board was replaced and clamped to the top flange of the drag, and the rollover board was clamped to the lower flange; after which the crane with a beam and slings was attached to the trunnions and the drag was rolled over. It was lowered back onto the same bed, the crane disengaged and the rollover board removed. The heap sand was shoveled out down to the parting line and a parting made.

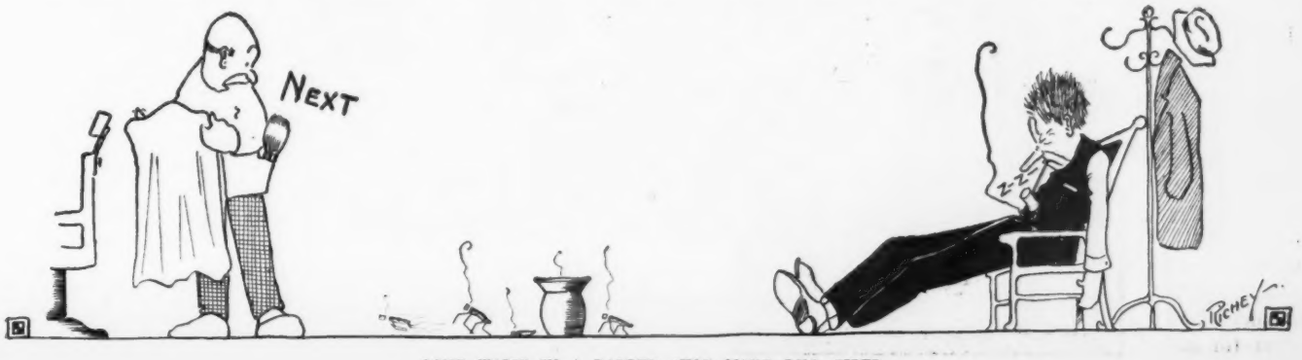


MOLD SEPARATED—DOTTED LINES INDICATE WHERE CUTTING TOOK PLACE

"The arms and hub part of the pattern was then set on and located by suitable dowels and dowel pins provided for that purpose. It was necessary to make a small excavation for the bottom core print, but this was made up after the pattern was settled into its place. Dry parting sand was sprinkled over the horizontal joint and wet parting sand slicked with a trowel on the part of the joint which sloped up to the horizontal at the periphery of the teeth and also on the exposed ends of the sand teeth. Facing sand was riddled all over the surface and the cope was put on. The bars in the cope were straight and the parting was considerably below the flask joint and this meant that quite a heavy body of hanging sand would have to be supported. We could have wedged chucks between the bars and gaggered the face, a procedure which would have been quite necessary in some cases, especially if the lift was deeper than the width of the bars; or we could have hung hooked gaggers over the bars, but we did neither. We used long soldiers, set in rather thickly, and they answered the purpose perfectly besides furnishing a much more rapid method than either of the others. When the soldiers all had been set, facing sand was riddled in to a depth of 1 inch and then heap sand was filled in for an additional 3 inches. This course was hand rammed to insure an even density of sand and also as being less likely to disturb the soldiers. Gate sticks were then located; two 1-inch pins on the hub for runners and one on the extremity of one of the arms to serve as a pop or flow off. A 4-inch riser tapered down to three inches was set on the hub for a feeder. Two more courses of sand were shoveled in and rammed, and the last course was butted off flush with the top of the flask. The cope was then vented and the gate sticks withdrawn. The crane with the beam and slings was attached and the cope lifted off, turned over and lowered upon a couple of blocks.

"No screws were needed to bring away the arms and hub part of the pattern the force which we had heard of in our school days as attraction of cohesion being sufficient for that purpose. According to time honored precedent, which unlike some precedents is based on common sense, the drag was finished first. Under ordinary circumstances the cope half of a job is attended to first, except of course where two or more men are doubled up. In such cases one or more of the men takes each part and both cope and drag are finished simultaneously. In the present instance I was working alone and drew the drag part of the pattern first to prevent it from warping. If the pattern had been in one piece, with the arms attached firmly to the rim this precaution would have been unnecessary.

"After the pattern had been drawn out of the mold and put away, the face of the mold was sprayed with molasses water. In these present degenerate days




LONG WAITS IN A BARBER SHOP MAKE BILL TIRED

this feature of the work is accomplished with a spray can, and in the days whereof I speak some of the younger generation of molders used them; but the old guard scorned all such contraptions and sprayed the work in the same way the heathen Chinee sprays his clothes before ironing them. That is to say they converted themselves, for the time being, into human atomizers. Like many other details of the molding trade this feature is exemplified more or less perfectly by different men. Some, who are master hands, develop an expertness that is really amazing while others are just about as graceful as a hippopotamus with the toothache.

"While the mold was being rammed the patternmaker had prepared two loose teeth, exact counterparts of those on the wheel but two inches shorter. These were dropped in turn in all the teeth, and the sand tooth between, in each case, was cut off and beveled to correspond to the bevel on the making-up teeth. After all the teeth had been trimmed they were given a coating of blacking mixed with molasses water, and dried with an oil torch. This is quite a common feature in present day foundry practice but it was considered quite a novelty back in 1900. The center or hub core was then set and a couple of pieces of thin scrap were laid on the bottom face of the hub to catch the first fall of the iron from the gates.

"For finishing the cope the pattern shop had supplied a segment piece which was located accurately by keeping the thickness blocks at each end hard against the face of the mold. Sand was packed in the open space between the block and the old face, and held in place by a row of 6-inch spikes around the top and two rows of 4-inch nails inserted after the block was removed. The segment was moved around and sand packed in until the entire circle was completed. The arms and hub were then withdrawn and the ends of the arm impressions in the mold were stopped off to correspond to the new rim face.

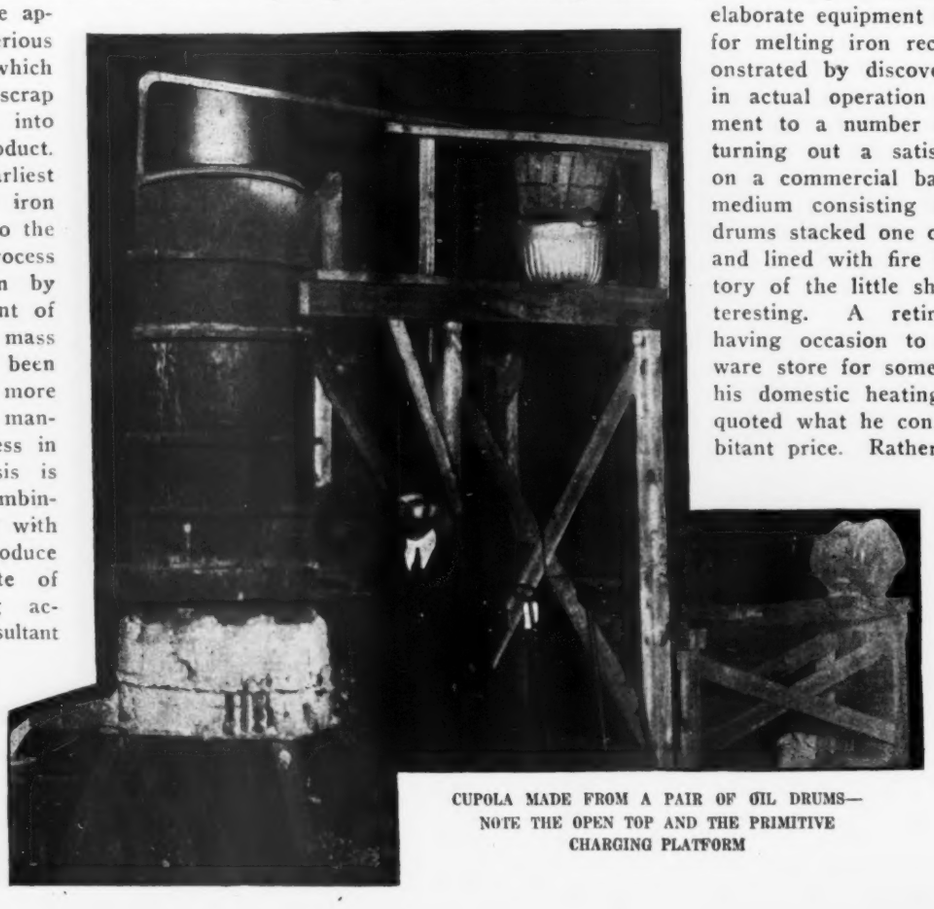
"Dry blacking was shaken over the cope face from a bag after which the crane was attached and the cope was turned over and lowered upon the drag. It was lifted off once to see if any damage had been done and then replaced. Weights were set on, the runner and riser made up and the mold was poured with a semisteel mixture. The hub was fed-through the riser as long as possible. As soon as the hub had become solid the top was stripped and the center core dug out to equalize the strain in cooling."

The barber butted in here and asked Bill if he wanted a haircut or not. "Oh no," said Bill. "Not at all. Do you think I came in here to get my teeth sharpened?" Then as he climbed into the chair and prepared to go to sleep he turned to me and remarked in a loud voice: "There are three things in this world that I have no use for—long hair, long sermons and long waits in a barber shop. Proceed, barber; cut it short all over."

# Home Made Cupola Meets Requirements

BY H. D. McCLINTOCK

THE foundry cupola always has been regarded with a feeling of awe, especially by those who are not well acquainted with the apparently mysterious process by which crude iron and scrap are transformed into a useful product. From the earliest period when iron was fabricated to the present the process of melting iron by forcing a current of air through a mass of fuel has been practiced in a more or less efficient manner. The process in the last analysis is simply the combining of oxygen with carbon to produce heat. The rate of this combining action and the resultant production of heat depends upon the supply of oxygen available. Through evolution the accepted mechanical equipment for melting iron today consists of a cylindrical iron stack lined with an insulating, heat-resisting material and provided with openings near the base through which a blast of air is forced. In its essentials and methods of operation this does not differ greatly from the primitive cupola of early days. That elaborate equipment is not necessary for melting iron recently was demonstrated by discovering a foundry in actual operation giving employment to a number of molders and turning out a satisfactory product on a commercial basis, the melting medium consisting of two old oil drums stacked one on top the other and lined with fire brick. The history of the little shop is rather interesting. A retired foundryman having occasion to go to a hardware store for some repair parts of his domestic heating apparatus was quoted what he considered an exorbitant price. Rather than pay it he declared that he would build and equip a small place for the production of his own castings. The results attained were sufficiently satisfactory to permit placing the production on a commercial basis.



CUPOLA MADE FROM A PAIR OF OIL DRUMS—NOTE THE OPEN TOP AND THE PRIMITIVE CHARGING PLATFORM

(*Concluded on page* 125)

# Electric Versus Converter Steel

## A Summary of the Results of Work Carried on During the War—A 3-ton Electric Furnace and a 3-ton Converter Were Used in One Shop Side by Side Affording Identical Conditions for Comparison

BY JOHN H. HALL AND G. R. HANKS

AT OUR High Bridge plant we have a 3-ton heroult electric furnace and a 3-ton bottom-blown bessemer converter working side by side. The electric furnace is operated on a basic bottom, which enables us to turn out steel very low in sulphur and phosphorus.

During the war we had orders for castings for the army and navy, and in order to use our converter for castings of this class we installed the Stoughton oil-burning process on our cupolas, by which we were enabled to turn out steel sufficiently low in sulphur to meet the government's specifications and in many cases to get sulphur considerably below 0.06 per cent.

We had always been able to meet the tensile tests for Classes 1, 2 and 3 army and navy A, B, C and D steel with converter metal and after we had the oil on the cupolas working successfully we undertook to turn out army and navy work with converter steel as well as with electric steel.

We had not gone very far with the more intricate castings before we were faced with the fact that the converter steel, even when the sulphur was around 0.05 per cent, was much more subject to hot cracks and tears than the electric steel and apparently it was not always true that the lower sulphur heats were any better in this respect than the high sulphur heats.

In order to throw some light on this question we kept very careful records on one of the cradle-band castings for 240-millimeter howitzer. These castings were of Class 3 steel but in our practice we poured them with steel running from 0.25 to 0.35 per cent carbon and secured the desired high tensile strength by heat treatment. The accompanying table gives the analyses of a number of converter and electric heats from which castings of this pattern were poured and shows clearly the large proportion of cracked and torn castings on the converter steel. An examination of this table will show that in the converter heats on which no castings were lost the sulphur was as high or higher than on the heats on which castings were rejected for hot cracks. It will also be noted that at least one of the electric furnace heats (No. E491) is not very low in sulphur and on this heat we lost no castings. In fact electric heat No. E491 with 0.032 per cent sulphur is directly comparable with converter heat No. 68528 with 0.038 per cent sulphur, on which a casting cracked.

In our efforts to overcome the hot tears in the foundry we used all of the "stunts" that could be worked out with any reasonable theory behind them and some of them were as follows: The castings were made in both green and dry sand; they were taken out of the molds hot; were allowed to cool over night, etc. Some of these same molds were relieved to allow free shrinkage by destroying the sand grip, while other molds merely had the cope lifted and were allowed to remain until they were cold. During our experiments as above enumerated we determined that the castings poured from electric steel could be handled in most any manner that time and equipment would allow and our results produced very few rejections, whereas with castings poured from converter steel we were unable to produce any large proportion of good castings regardless of the manner in which they were cared for.

Somewhat later we undertook the manufacture of rudder stocks and stern frames for merchant ships, and our experience on these castings was even more illuminating than on the smaller castings for ordnance work. The reason for this, of course, was that the castings were so long as to give a very great total shrinkage amounting to 5 inches. Our first really conclusive test on these castings came when we were obliged to pour a rudder stock from two heats of converter steel which analyzed as follows: Carbon, 0.29 to 0.31 per cent; silicon, 0.51 per cent; manganese, 0.77 to 1.01 per cent; sulphur, 0.066 to 0.057 per cent; and phosphorus, 0.052 to 0.056 per cent.

This casting was scheduled to be poured from one converter heat and one electric furnace heat, mixed, but owing to trouble with the electric furnace we were obliged to pour it entirely of converter steel. Every precaution was taken to relieve this casting so that the shrinkage would not result in hot checks, the sand being dug out from around the heads and the cope lifted off the casting about 30 minutes after pouring. We were naturally somewhat afraid that we would have hot checks in this casting, but when the cope was lifted off and we found the casting torn in three pieces our feeling may be more easily imagined than described. Within a few days the same casting was poured successfully of electric furnace steel which analyzed as follows: Carbon, 0.30 per cent; silicon, 0.38 per cent; manganese, 0.85 per cent; sulphur, 0.021 per cent; and phosphorus, 0.019 per cent.

We afterward successfully poured these large castings and also large stern frames, sometimes with electric furnace steel alone and sometimes with electric steel and converter steel mixed. The analyses of several heats on which we successfully poured castings of this class are given below:

| Kind of heat | Carbon Per cent | Silicon Per cent | Mang. Per cent | Sulp. Per cent | Phos. Per cent |
|---|---|---|---|---|---|
| Electric | 0.26 | 0.38 | 0.82 | 0.02 | 0.024 |
| Electric | 0.37 | 0.42 | 0.94 | 0.019 | 0.033 |
| Converter | 0.37 | 1.10 | 1.51 | 0.047 | 0.045 |
| Electric | 0.27 | 0.78 | 0.94 | 0.030 | 0.036 |
| Converter | 0.27 | 0.24 | 0.67 | 0.045 | 0.046 |

Examination of these analyses shows that the average sulphur in the two castings poured of electric and converter steel mixed is 0.033 per cent in one case and 0.038 per cent in another.

Naturally, in the rush of war work we were too busy to keep very complete records, but our experience convinced us that the electric steel was superior to the converter steel from the standpoint of hot checks and we had several cases besides those given above where steels of practically identical analyses as regards sulphur ran true to form in the matter of hot checks, the converter steel giving considerably more trouble than the electric.

Our Easton shop at the same time was running a 6-ton basic electric furnace side by side with a 2-ton converter. In their electric furnace practice they did not work for as low sulphur as we did at High Bridge, but after they had been running a couple of months they were convinced that the electric steel castings were so much more free from hot checks that there was practically no comparison between the two steels. They had an experience on a large stern frame which was practically the same

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From a paper presented at the Philadelphia convention of the American Foundrymen's association. The authors John H. Hall and G. R. Hanks are connected with the Taylor-Wharton Iron & Steel Co., High Bridge, New Jersey.

**Data on Electric and Converter Heats**

| No. of Cast | Date | Heat No. | Carbon | Silicon | Mang. | Sulp. | Phos. | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | Per Cent | | | |
| 1 | 6/12 | E491 | 0.28 | 0.24 | 0.47 | 0.032 | 0.023 | |
| 4 | 6/13 | E497 | 0.34 | 0.51 | 1.40 | 0.014 | 0.040 | |
| 1 | 6/15 | E505 | 0.35 | 0.24 | 1.00 | 0.017 | 0.037 | |
| 3 | 6/19 | 68578 | 0.30 | .... | 0.87 | 0.047 | 0.049 | 2 cracked, torn |
| 2 | 6/19 | 68579 | 0.29 | 0.47 | 1.11 | 0.046 | 0.050 | 1 cracked, torn |
| 2 | 6/20 | 68592 | 0.27 | 0.56 | 0.84 | 0.065 | 0.041 | 1 cracked, torn |
| 1 | 6/20 | 68593 | 0.30 | .... | 1.13 | 0.055 | 0.043 | 1 cracked |
| 2 | 6/21 | 68609 | 0.26 | .... | 0.98 | 0.057 | 0.049 | 1 cracked, torn |
| 1 | 6/25 | 68657 | 0.27 | 0.38 | 1.00 | 0.070 | 0.045 | |
| 2 | 6/26 | 68675 | 0.24 | .... | 0.80 | 0.064 | 0.040 | 1 cracked, torn |
| 3 | 6/26 | E528 | 0.27 | 0.19 | 1.31 | 0.016 | 0.020 | |
| 2 | 6/26 | 68673 | 0.28 | 0.56 | 1.07 | 0.065 | 0.043 | |
| 1 | 6/27 | 68691 | 0.26 | 0.61 | 0.94 | 0.055 | 0.048 | |
| 5 | 6/28 | E532 | 0.31 | 0.33 | 1.00 | 0.015 | 0.027 | |
| 1 | 6/28 | E533 | 0.35 | 0.20 | 1.00 | 0.018 | 0.031 | |
| 3 | 6/29 | E538 | 0.30 | 0.28 | 0.93 | 0.014 | 0.020 | |
| | 6/14 | 68562 | 0.33 | 0.38 | 0.94 | 0.054 | 0.047 | 2 cracked, torn |
| | 6/14 | 68528 | 0.28 | .... | 0.88 | 0.038 | 0.045 | 1 cracked, torn |

as ours at High Bridge—a converter steel casting cracked so badly in the mold that it could not be used at all. The same casting poured from electric steel with a little converter steel to fill up the heads came out practically free from hot checks.

At Easton one of the regular lines of manufacture is castings for track work which are poured from a hard grade of carbon steel. These castings are of intricate design and the men in charge of that foundry have been making them regularly for 15 or 20 years. In talking with them they remarked that during the 15 years they had poured them of converter steel they had grown to regard hot checks in these castings as a matter of course, but that after a short experience with the electric furnace steel they were able to turn out these castings practically free from checks with no more care in handling, and in fact, in many cases, with less care than was used for the converter steel.

We do not wish to be understood as stating that we believe that sulphur has nothing to do with hot checks in steel castings, but we do feel that sulphur is by no means the only thing which makes converter steel liable to these defects. In fact our own individual opinion is that although sulphur is a contributing cause it does not have as great an effect in causing hot cracks as does the method of manufacture of the steel.

# Why Castings Cost More

WITH a view to educating its customers to the reasons for advances in castings prices and to counteract any insinuations that the foundry industry in general is advancing prices unreasonably, the Thomas Devlin Mfg. Co., Philadelphia, has issued a series of circular letters setting forth some basic truths. These letters, which have been prepared under direction of the company's president, Thomas Devlin, present a comparison between costs obtaining at present and those which governed the manufacture of castings in 1909. It is pointed out that the cost of every commodity entering into the production of castings has increased. According to one of the circulars, the average advance in the cost of labor from 1909 to September, 1919, was 172.6 per cent, most of which occurred since 1914. The advances in wages of five of the most important mechanics and laborers in the Devlin plant follow:

COMPARISON OF WAGES

| | Rate per hour 1909 | 1919 | Increase Per cent |
|---|---|---|---|
| Date rate molders | $0.30 | $0.75 | 150 |
| Piece rate molders | .30 | .875 | 190 |
| Machinists | .30 | .698 | 133 |
| Toolmakers | .30 | .77 | 157 |
| Laborers | .15 | .50 | 233 |

These percentages were determined from the following data:

HOURS AND WAGES IN 1909

| | Wages per week | Hours per week | Rate per hour |
|---|---|---|---|
| Day rate molders | $18.00 | 60 | $0.30 |
| Piece rate molders | 18.00 | 60 | .30 |
| Machinists | 18.00 | 60 | .30 |
| Toolmakers | 18.00 | 60 | .30 |
| Laborers | 9.00 | 60 | .15 |

HOURS AND WAGES SEPT. 1, 1919

| | Wages per week | Hours per week | Rate per hour |
|---|---|---|---|
| Day rate molders | $36.00 | 48 | $0.75 |
| Piece rate molders | 42.00 | 48 | .875 |
| Machinists | 33.50 | 48 | .698 |
| Toolmakers | 37.50 | 48 | .77 |
| Laborers | 24.00 | 48 | .50 |

Moreover, an average advance of 100 per cent in the cost of raw materials has taken place and war taxes including capital stock tax, income tax, excess profit tax and increased municipal taxes must be added to the cost of producing manufactured goods.

To illustrate specifically how the price of castings has increased, Mr. Devlin points out that the iron in the castings sold in 1909 for $0.06 per pound cost a fraction less than $0.01 per pound. After deducting 10 per cent as profit a balance of $0.045 is left to pay for molding, melting, assorting and all overhead expenses. By comparisons similar to that previously made in this article the average increase and the cost of labor up to January, 1920, is found to be 189 per cent. At this rate the original balance of $0.045 is increased to $0.085. This must be added to $0.054, the original cost in 1909 obtained by deducting 10 per cent from the selling price at that date. To this also must be added $0.01 for the increased cost of iron since 1909, $0.011 for increased cost of superintendence, and $0.0149 for a profit of 10 per cent, making a total of $0.165, which is the selling price in 1920.

Because of these increases it now is necessary to charge customers $0.275 per pound for castings which sold for $0.10 in 1909 and $0.427 for castings formerly selling at $0.15. In the same manner more intricate work which sold for $0.20 in 1909 now must bring $0.562 a pound. These prices consider only cost prices with an additional 10 per cent for profit and a small percentage for the additional cost of superintendence. On account of the unsettled condition of the price of labor it is not possible to guarantee quotations on castings for any time in advance.

## New Foundry Organized in Buffalo District

W. B. Peirce, general superintendent of the Buffalo Bolt Co., North Tonawanda, N. Y., for the past 10 years, has resigned to take the presidency of a newly incorporated company known as Peirce, Brown, Inc., which will conduct a general foundry business. The company is incorporated for $350,000, the secretary and treasurer will be S. W. Brown, formerly secretary and treasurer of the Frontier Chocolate Co., while two of the directors will be T. J. Wilson, chairman of the board of the Herschell-Spillman Co., and Ralph Plumb, vice president of the Buffalo Bolt Co. The company has purchased 10 acres and will let contracts for a building, 100 x 300 feet, of brick and steel construction in which it is hoped to begin operations before June 1. This will be equipped with the latest and most modern equipment.

# Making a Pulley Without a Pattern

## Economical Methods Utilized to Save the Expense in Time and Material of Making a Costly and Elaborate Pattern Where Only One Casting Was Wanted

BY JOSEPH ALLEN

WE received an order not long ago for a double arm pulley, 4 feet in diameter with a 4-foot face. There was only one wanted so the rigging had to be made as simple and inexpensive as possible. With this object in view we had two sweeps made, one for the exterior and one for the interior; also one corebox containing a half pattern for the arm and one corebox for making the hub.

While the coremaker was making the cores, the molder selected a flask and prepared to fit it up for the mold. We were fortunate in having several sections of 5-foot round flasks each 1 foot deep. They were all provided with a sand lifting strip about 1½ inches wide around the lower edge. These flasks were often used for jobs where there was no use for the sand strip but on other occasions like the one under discussion, they came in right handy. A bottom plate and drag were put down first and leveled approximately. The spindle seat was then set on the bottom plate and bolted loosely into place. The next step was to set the spindle plumb. This was effected by wedging up the spindle seat until the desired position was secured. The bolts in the seat were then tightened up; an arm was slipped on the spindle and the drag wedged up wherever necessary until the arm, swinging around, touched the upper face evenly all over, the drag of course was centered from the spindle.

When everything was set, the drag was filled with sand, rammed, struck off even with the joint and the parting made and slicked. Parting sand was sprinkled on the joint and the first section of the cheek claywashed and set on.

We borrowed a section of 46-inch smokestack from the boiler shop and used it for a ring to ram against. It was only 3 feet on the face but we drew it up as we went along. The rivet holes in the top edge proved a great convenience for holding the lifting hooks. We set a row of gaggers around the bottom, faced up the ring, filled in 6 inches of black sand and rammed it firmly. Another course of facing and black sand followed the first and then the second part of the flask forming the cheek was set on and clamped to the preceding one. The same procedure was gone through with the two succeeding sections with the exception that several pieces of scrap 1-inch thick were placed between them. This was for the purpose of making the mold 2 inches longer than the casting. In other words since we intended to pour the mold open, we were providing for two inches of head metal. The two ends of the pulley had to be trued on a lathe and it was immaterial to the machinist whether he had to cut off ½-inch or 2 inches.

THE MOLD FOR MAKING THIS CASTING WAS POURED OPEN, PROVISION BEING MADE FOR 2 INCHES OF HEAD METAL

When the cheek was rammed to the top, the section of smokestack was lifted out and the exterior sweep attached to the arm. A short piece of straight edge was fastened to the sweep with a couple of screws; it extended over the top flange of the cheek and served to make a top joint. After the outside face of the mold had been swept up true and smooth, the sweep was taken off the arm and put away. The cheek was then lifted off and lowered on two iron horses. It was felt all over for soft spots; any irregularities discovered were mended and after being slicked all over it was given a coat of wet blacking. It was then covered with a few pieces of corrugated iron and a fire maintained underneath until it was dry. In ramming the inside of the mold the sweep had to be used twice before the top was reached, first, to make a seat for the lower set of arm cores, then a seat for the upper arm cores and finally the top joint.

The first step was to set the section of smokestack centrally in relation to the spindle. It was just the right size for the inside of the mold and had to be located accurately, otherwise the arm cores would not fit in their places. The inside was faced and rammed up to the approximate height for the first set of arm cores. Then the curbing was lifted off and the sweep attached to the arm. This sweep had two marks on it which had been transferred from the layout board in the pattern shop. The marks corresponded to the position the arm cores were to occupy in the mold. A piece of straight edge was attached to the sweep at the lower mark and with it a level bed was struck off. The sweep was then removed and the lower hub core slipped down the spindle and bedded in flush with the bed prepared for the arm cores. The arm cores were then set, the inner ends locating themselves by the circle of the hub core and the outer ends being spaced with a pair of trammels. A piece of 5-inch stock core was then placed in the hub and the top half of the hub core put on. This hub core was provided with two gate openings each 1½ inches in diameter.

The curbing was put on again, a gate pin placed in each hole and the sand rammed high enough for the seat of the second set of arm cores. They were located in the same manner as the lower set. Gate openings were provided in both top and bottom hub cores in this set, those in the bottom being placed over the openings left by the gate pins previously referred to.

When the cores were all set, gate pins were placed in the gates in the upper hub core, the curbing replaced and sand rammed up to a predeter-

mined height. The curbing was then removed, the sweep reset and the mold slicked and finished. The reinforcing rib was made by bedding in a segment all around. Provision had been made in the end of the arm corebox for this rib. The segment was located accurately each time by resting the ends in the gaps in two of the arm cores. Before drawing the segment pattern a row of 4-inch nails was driven in the sand immediately above it. After taking out the spindle and sweep, a round plate with a 12-inch opening in the center was bedded down on top of the mold. The face was then given a coat of wet blacking and dried with a torch. After it was dry the cheek was lifted, set back in its place and clamped to the drag. Two pieces of rails were laid across the top, resting on the flange of the flask but clearing the plate on the core by about ½ an inch. When the rails had been secured with clamps to the top flange of the flask, wedges were driven between the plate and the rails.

A flat iron plate about 15 x 24 inches was set on the top joint. It extended from the edge of the flask well in over the core. A runner was built up on this plate reaching in and embracing the two gate pins. Particular care was taken in making up the runner so that no loose particles of sand would wash in with the iron. A slab core was placed in the bottom of the basin and the trough was tooled smooth with a trowel. Three men with long ¼-inch rods watched the metal coming up and any small lumps of dross which formed at the outlet of some of the arms were touched with the rods and kept moving to avert dirty spots in the casting.

# An Automatic Brake For Traveling Cranes

FOR use in connection with overhead traveling cranes, Aaron Heisler, Pittsburgh, has invented and patented a new safety device which he claims will prevent wheeled cranes or the crane structures from traveling too far upon the supporting rails. As shown in the accompanying illustrations, the safety feature is a sliding bumper which upon contact with another crane or with the end walls of the crane runway applies a brake to the motor shaft.

When the bumper strikes an object in the path of its travel, it moves a wire cable attached to a bellcrank lever, which in turn opens a valve in the air line connecting an air reservoir with a brake cylinder. A rack mounted on the piston of the brake cylinder actuates a pinion on a right and left-threaded shaft of a clasp brake on the crane motor shaft. To release the brake, air is discharged from the brake cylinder through a valve controlled by the cab operator. In order to prevent sudden shock the cable is provided with an air cushioning cylinder which tends to absorb the jar.

To apply the device to the crane it is necessary to install an air tank and pump, piping and necessary fixtures, and a separate motor which, the inventor says, need not be of high power. Fig. 1 is a side view of the crane with the appliance attached. It shows the air tank surmounted by the motor and pump, the brake cylinder, bell crank and clasp brake. Near the top of the crane is the air cushioning cylinder and the brake wheel. Fig. 2 is an end view of the carriage showing the safety bumper and the cable attached to it. Fig. 3 shows the principal of the brake wheel which is operated by the rack on the piston rod.

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The International Oxygen Co., Newark, N. J., is establishing a branch plant at Toledo, O., to furnish oxygen and hydrogen for manufacturing purposes. The new plant will have a capacity of 3,000,000 cubic feet per month.

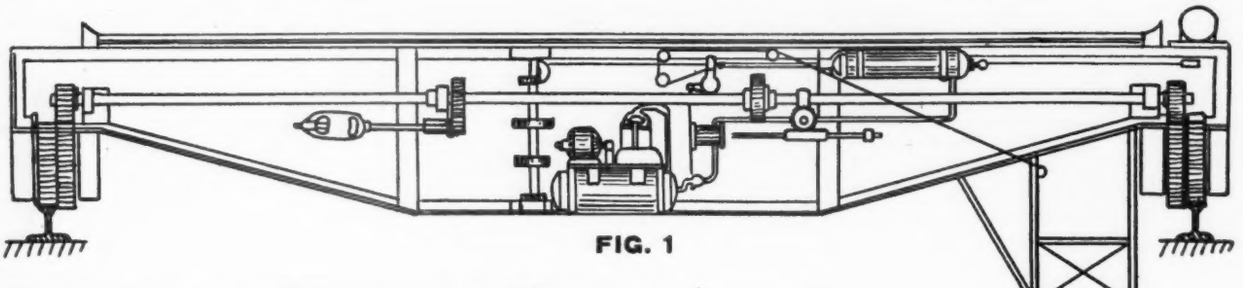


FIG. 1

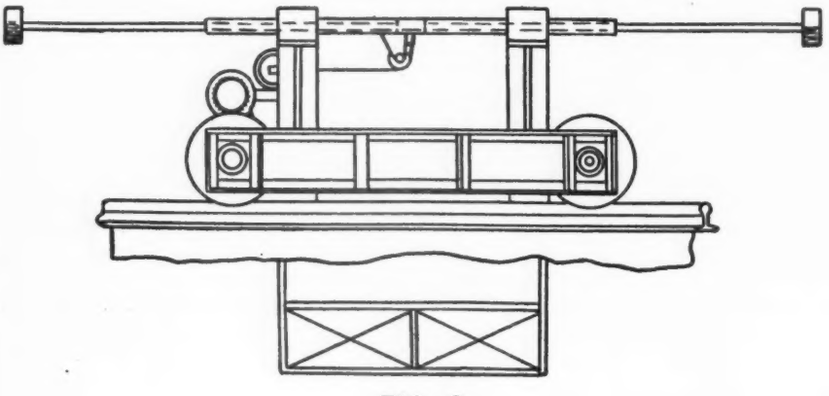


FIG. 2

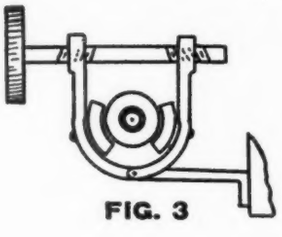


FIG. 3

AIR OPERATED DEVICE FOR PREVENTING ACCIDENTS ON OVERHEAD TRAVELING CRANES DUE TO RUNNING PAST SAFE LIMITS

# Making a Chilled Iron Special Roll

*Question*: We make castings for a firm which manufactures textile machinery. Recently this concern asked us to supply fifteen 12-inch chilled iron rolls. We have had no experience in this class of work and would appreciate any information you could give us on the subject.

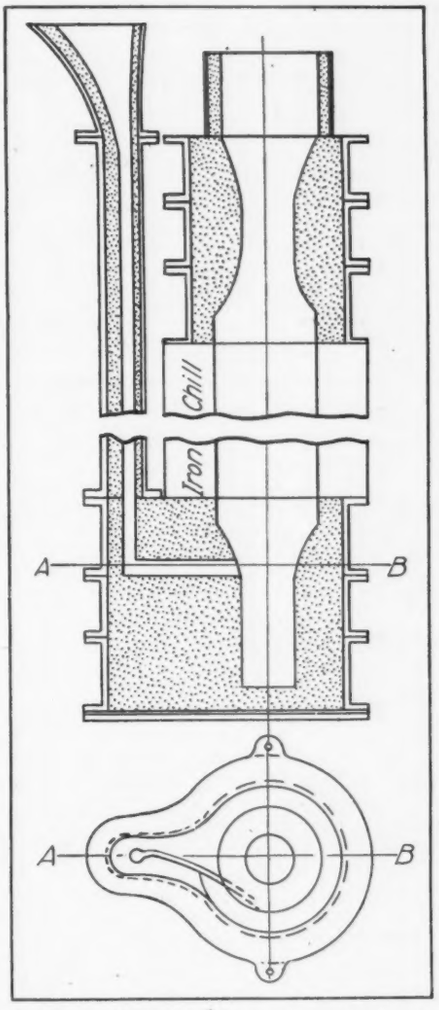
*Answer*: Casting chilled rolls is a highly specialized branch of the foundry business and we think you could buy the rolls from a regular roll shop much cheaper than you could rig up and make them. However, if you wish to try, we shall not attempt to discuss roll making in general but confine ourselves to a description of the rigging necessary for making the roll which you have in hand at present. Since there are only 15 to make, one outfit will be sufficient to get the job out in time.

The outfit will consist of one chill 11¾ inside by 24 inches outside diameter and 4 feet long, all rough sizes. It will weigh about 4200 pounds and must be machined on the inside and at both ends. Two round iron flasks 18 inches inside diameter will be required, one for the cope and one for the drag. Each one is to be 24 inches deep and may be cast in one piece or in three sections as shown in the accompanying sketch.

Two patterns will have to be provided for making the flasks. The cope flask is perfectly round but the drag flask has a pocket to accommodate the gate. The sketch shows the assembled general arrangement. The face of the flask which comes in contact with the chill is machined. This applies of course to both cope and drag and is for the purpose of assuring alignment when the mold is assembled. There are two lugs on the chill at each end and two lugs on the joints of the flasks to correspond. Pin holes are drilled in all the lugs through a jig. The same jig is used to locate the holes in the board on which the flasks are rammed up.

The same pattern may be used for both the top and bottom necks. The mold for the top neck is reamed out to form a continuation of the shrink head before it goes in the oven. You will need a runner box and pouring basin. The former is a cast-iron trough flanged at both ends and along the open side. In this case it will be 6 feet long. The pouring basin may be either cast iron or boiler plate.

Having assembled all the gear we will now proceed to make the mold. The mold board is put down first and the drag set by dropping pins through the lugs in the flange which has been machined and which is now placed in contact with the board. It is understood that this board is planed perfectly straight and has a hole for a dowel pin bored in the exact center. The neck pattern is then set in and is located by a center dowel pin which fits in the hole in the board. Stand an upright gate pin 2 inches in diameter in the pocket of the flask and bank facing sand around the pattern and gate pin to a height of 6 inches, then




SHOWING ASSEMBLED MOLD FOR CHILLED ROLL AND DETAIL OF GATE

fill in black sand to the same height and ram it hard. Level a place off with the trowel and cut a gate tangentially from the gate pin to the pattern. Draw the gate pin, give the gate a lick of blacking and cover the gate with a piece of slab core. Ram the balance of the drag, turn it over, draw the pattern, black the mold and place it in the oven to dry.

Place the pattern back on the board and ram the cope, take it off, black, and run it into the oven; then make up the runner and pouring basin. The runner is made by first ramming about two inches of sand in the box. Then lay in the gate stick which is the full length of the box, rap it down firmly. Fill the box full of sand and butt it off, then scrape off the superfluous sand, bed on a long piece of boiler plate and clamp it. Rap the gate pin at one end and pull it out through the other end of the box. The runner, pouring basin and chill all go in the oven.

When the mold is dry, the car is pulled out of the oven. The drag is taken off first and set down level in the bottom of a pit. Of course a pit is not an actual necessity but it is a great convenience and renders the pouring of the mold much easier. The chill is then taken off and given a coat of blacking mixed with molasses water, after which it is set on the drag, being located by the pins previously referred to. The cope is rolled over and put on next, then the runner box and pouring basin. The runner box is clamped to the flange of the drag and the pouring basin clamped to the runner. No clamps are used to hold the mold together.

Something over a ton of iron will be required to pour the mold and it must be driven in as rapidly as possible until the mold is filled. If a generous shrink head is provided and the metal covered with half a shovelfull of dry blacking, no further feeding will be necessary. When pouring the mold the shrink head is not filled all the way. It is filled to the top with a bull ladle after the big ladle has been taken away.

A suitable analysis for the chill would be: Silicon, 1.75 to 2.25 per cent; sulphur, 0.07 per cent; phosphorus, 0.20 to 0.40 per cent; manganese, 0.40 to 1 per cent; total carbon, 3 to 3.50 per cent. For the roll: Silicon, 0.60 to 0.80 per cent; sulphur, 0.06 to 0.08 per cent; phosphorus, 0.20 to 0.40 per cent; manganese, 1 to 1.20 per cent; total carbon, 3 to 3.25 per cent. The iron for these castings must be poured very hot and fluid. A small chill test should be taken before pouring the ladle and the fracture noted.

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The great demand for chromite during the war led the United States geological survey, department of the interior, to make special examinations of deposits of this mineral. A statement on the results of one of these examinations is contained in a "Preliminary Report on the Chromite of Kenai Peninsula, Alaska," by A. C. Gill, just published by the geological survey. The deposits described occur at two localities, both in the southern part of the Kenai peninsula. One is on tidewater at Port Chatham and the other about 16 miles inland. Large bodies of ore have been found at both localities.

# THE FOUNDRY

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# Stock Iron by Silicon Content

CUSTOMS which in former days were established and practiced for a reason, today are carried on when the reasons largely have been obliterated by new methods or modern developments. One of these is the established practice of placing each carload of pig iron in a separate pile in the foundry yard. In the not far distant past before chemistry was applied in foundry metallurgy, the only properties of pig iron which the foundryman knew were judged from the appearance of a fracture. Pigs were broken from every shipment of iron and grade was determined by the fracture as nearly as was possible. This method did not give accurate results, therefore the expediency of piling each car of pig iron in separate piles helped to locate trouble in cases where a wrong estimate of the grade of iron had been made. If the iron from the cupola was too hard it was easy to substitute pig iron from another car, changing the mixture until the metal was soft enough. Then too it was necessary to unload and pile the iron by manual labor. This limited the height of a pile to less than the height of a man under ordinary conditions. It also meant in some cases an immense yard space which could be more profitably employed.

With the introduction of chemistry and the invention of traveling and locomotive cranes which unload pig iron with a lifting magnet, the piling of each car of pig iron on a separate pile is unwarranted. Chemistry has enabled the blast furnace to guarantee to the foundry the composition of every carload of iron before the iron is received. Later the report may be checked by a second test at the foundry, if desired. With this information the foundryman can pile the iron according to silicon content or according to considerations of any special variations in other elements. Thus he may pile all iron within a certain silicon range, as reported by the furnace, on one pile. The allowable range may be regulated by the degree of accuracy demanded in the shop, but a range of one-half of 1 per cent is accurate enough for most work. With such an arrangement iron containing between 3.01 and 3.50 per cent silicon all is piled on the same pile and figured at 3.25 per cent silicon when calculating the mixture. Foundries which have tried this method find that by spreading the iron from each shipment over the whole pile, which can be easily done when unloading with a magnet, the iron will come from the cupola with a silicon content quite close to the amount calculated. Of course, if the iron on a certain pile tends strongly to the lower or upper silicon limit this can be taken into account when calculating the mixture and the iron from that pile figured as 3.15 or 3.35 per cent silicon depending upon whether it tends towards the lower or upper limit. However, this rarely will be necessary. In foundries where high and low phosphorus iron are used in different mixtures the iron should be piled according to phosphorus as well as according to silicon, but a single division of high and low phosphorus probably is the only division necessary to separate the iron according to the phosphorus classification. Yard space is conserved and the labor problem simplified by the adoption of the magnet to unload the iron and to move it close to the tracks for the scale men to weigh, or to load it upon cars to carry it to the cupola, or even to lift the iron directly from the stock pile to the charging platform of the cupola.

# Trade Outlook in the Foundry Industry

WITH order books crammed full of desirable business and customers clamoring for the privilege of ordering just a few more tons of castings, foundrymen are faced with a series of aggravating circumstances over which they have no control. Traced back to the final analysis faulty railway service and the shortage of labor are factors which at present are preventing the foundry industry from attaining maximum prosperity. Car shortage and traffic congestion are striking at the main material supplies and the labor scarcity continues to hamper both the preparation of foundry metals and fuel, and the production of castings when raw materials are at hand.

### Consider Coke

Probably in no direction is the influence of poor railway service better shown than in coke deliveries. It may be granted without question that the winter of 1919-1920 has produced an unprecedented pressure on the railroads. According to a statement by the director general, the week ending Jan. 3, 1920, showed an increase in revenue freight loaded of 162,228 cars over the same week of 1918 and 216,269 cars over the same period of 1918. This condition coupled with the fact that practically no rolling stock nor motive power has been added during the past two years has brought the burden which the railways have been incapable of handling. Further, the customary winter congestion at terminal points has been complicated by severe weather and shortage of available labor to handle and unload cars. In the coke regions a car shortage has prevailed approaching in severity that which obtained in the winter of 1917-1918. From 30 to 50 per cent of the normal requirements has been the average of cars set during the past two weeks. Coke output, too, has been unsatisfactory, although a steady improvement has been noted since the strike period. Fixed prices have acted as a governor and effectively prevented a runaway coke market, but they also have served to set up a feeling among producers which at least is disinterested. Operators are working steadily on existing contracts, but with little effort to meet the demand for spot coke by additional production. The coke shortage has affected foundries both directly and indirectly. Yard stocks, depleted by the drain of operating during the coal strike, have steadily diminished in the past weeks, until in many quarters a shut-down on account of fuel shortage is only a few weeks distant. A few plants in fact have been forced to close down for a day or more at a time to await coke which was enroute. An interesting sidelight is furnished by a number of automobile shops near Cleveland which are using an egg-size coke from Indianapolis for cupola melting. This material, although well adapted to use in salamanders or in firing ovens previously has not been thought suitable for melting iron. Blast furnaces also are experiencing difficulties in getting coke.

### Iron Goes Skyward

The railway situation is having an effect on iron deliveries, although not to the same extent as is noted in coke. Southern makers have an ample car supply, running every day more than double the requirements. Labor here exerts a hampering influence. Where two men normally can load an open gondola or dump-type car holding from 40 to 50 tons in a 10-hour day, sufficient common labor cannot be had to handle the day to day output of even a 300-ton furnace. Locomotive cranes for handling iron have been rushed to blast furnaces which never before have found them necessary. Open-top cars, although scarce and in demand by northern merchant furnaces, are more plentiful in the south. These are supplemented by refrigerator cars sent into the region from the packing territory embracing Kansas City, St. Louis, Omaha and Chicago. These cars are used to return foundry iron to the north. A complication has been introduced by the growing demand for basic iron. Furnaces which normally have made basic, switched to foundry grades under the heavy demand for casting metal last fall. Many of these, although heavily booked for foundry iron, again have reverted to basic, as this material is more easily produced in satisfactory quality. Much third quarter iron, both of northern and southern foundry grades, has been sold.

**Prices of Raw Materials for Foundry Use**

CORRECTED TO JAN. 26

| Iron | | Scrap | |
|---|---|---|---|
| No. 2 Foundry, Valley | $40.00 | Heavy melting steel, Valley | $28.00 to 29.00 |
| No. 2 Foundry, Birmingham | 40.00 | Heavy melting steel, Pittsburgh | 28.50 to 29.00 |
| No. 2 Foundry, Chicago | 40.00 | Heavy melting steel, Chicago | 24.00 to 24.25 |
| No. 2 Foundry, Philadelphia | 42.10 to 43.10 | Stove plate, Chicago | 33.00 to 33.50 |
| Basic, Valley | 40.00 | No. 1 cast, Chicago | 42.00 to 42.50 |
| Maleable, Chicago | 40.50 | No. 1 cast, Philadelphia | 36.00 to 38.00 |
| Malleable, Buffalo | 41.25 | No. 1 cast, Birmingham | 29.00 to 30.00 |
| | | Car wheels, iron, Pittsburgh | 39.00 to 40.00 |
| Coke | | Car wheels, iron, Chicago | 36.50 to 37.00 |
| Connellsville foundry coke | $7.00 | Railroad malleable, Chicago | 32.00 to 32.50 |
| Wise county foundry coke | 8.25 | Agricultural malleable, Chicago | 32.00 to 32.50 |

### Orders Are Plentiful

In all lines customers are seeking to place additional orders for castings, and endeavoring to secure early deliveries on contracts already placed. The automobile business which was the prime mover at the start of the present activity, continues to furnish an undiminished demand. Available foundry capacity is at a premium in gray iron and malleable lines, and even with new construction which it is estimated will add fully 10 per cent to existing foundry facilities, little opportunity to place new orders is anticipated before midsummer. The cast pipe demand continues heavy even with a recent advance in price which makes the average about $3 per ton higher than in 1918 Plumbing supply foundries in general are four or five months behind with orders, according to William M. Webster, Chicago, commissioner of the National Association of Brass Manufacturers. Nonferrous prices, based on New York quotations follow: Copper, 18.75c to 18.87c; lead, 8.50c; tin, 62.50c to 62.62c; antimony, 11.25c; aluminum, No. 12 alloy, open market, 30c to 31.50c, and producers' price, 31.50c. Zinc is quoted at 9c to 9.20c, St. Louis.

# Comings and Goings of Foundrymen

JOSEPH P. KENNEDY, president of the Baltimore Malleable Iron & Steel Casting Co., and the Kennedy Foundry Co., Baltimore, recently has organized the Kennedy Corp., which will erect a plant at Curtis Bay, Md. This new plant will specialize in automobile and tractor parts, such as cylinders, transmission and rear axle housings and other castings. The company, which is capitalized at $2,000,000 expects to complete its first unit by May 1.

A. P. Stephenson, credit manager for the National Malleable Castings Co., Cleveland, has been promoted to be local treasurer for the company at its Indianapolis branch.

I. G. Brown, formerly assistant superintendent for the American Brake Shoe & Foundry Co. at Mahway, N. J., has been made superintendent for that company at its plant in Norwood, Mass.

A. K. Kimmel retired as president of the Youngstown Stove Co., Youngstown, O., Jan. 1, 1920, when the company became consolidated with the Victor Stove Co., Salem, O.

F. H. Maple, formerly superintendent of the Point St. Charles plant of the Canadian Steel Foundries, Ltd., Montreal, Quebec, now is foundry superintendent of the American Steel Foundries plant at Alliance, O.

F. R. Good, formerly affiliated with the Belton Machine Tool Co., Bridgeport, Conn., has been made superintendent of the new foundry now being operated by the Connecticut Co., Bridgeport.

Robert Allcock of the Union Mfg. Co., New Britain, Conn., has become superintendent of the foundry of Landers, Frary & Clark of that city, and will be assisted by William Albrecht in an advisory capacity.

Walter C. Fish, since 1894 general manager of the Lynn, Mass., works of the General Electric Co., has resigned to become manufacturing engineer of the International General Electric Co., and will be located in Europe. He has been succeeded by Richard H. Rice, who has been acting general manager since Mr. Fish was taken ill a year and a half ago.

Emory R. Johnson, dean of the Wharton School of Finance, University of Pennsylvania, Philadelphia, addressed the members of the Philadelphia Foundrymen's association at the January meeting. He spoke on the problems connected with the return of the railroads to private ownership on March 1. J. S. Kunkle, Philadelphia, at the same meeting exhibited a number of motion pictures showing the use of tractors and trailers in foundry hauling.

H. C. Coleman, who was identified in various capacities in the Standard Sanitary Mfg. Co., Pittsburgh, for 10 years and was general purchasing agent of the Allegheny Steel Co., Pittsburgh, for about a year, now is Pittsburgh district manager for the Union Petroleum Co.

J. E. Kelley, formerly with the Chain Belt Co., Milwaukee, has accepted a position as foundry superintendent for the Lockport Foundries Corp., Lockport, N. Y., which about March 1 will start operations in a new plant constructed to manufacture malleable iron unions and fittings.

JOSEPH P. KENNEDY

Stuart B. Marshall, consulting engineer and metallurgist, who formerly was general manager of the American Manganese Mfg. Co., and general superintendent of the Aluminum Co. of America's North Carolina developments, recently of Roanoke, Va., now has his headquarters in Washington.

Edward A. Woodworth has been appointed special railroad representative at Chicago for the Chicago Pneumatic Tool Co., Chicago. Recently Mr. Woodworth has been secretary of the committee on standards of the railroad administration. Previously he was associated with the Oxweld Railroad Service Co. and the O'Malley Barre Valve Co. C. E. Laverenze, formerly inspector in the ordnance department of the navy also has been appointed special railroad representative by the Chicago Pneumatic Tool Co.

J. R. Mathews who has been New York representative for a number of years of the Mahr Mfg. Co., Minneapolis, has been transferred to Detroit and assigned the Michigan territory of that company for the sale of oil burning equipment. A. S. Hayes has been appointed to represent the same company in New York, and H. H. Keeler, formerly in charge of Oregon and Washington has been given northern Ohio with offices in Cleveland.

Charles C. Lee recently has returned from two years' service in Siberia with the Russian Railway Service Corps, during which time he was in charge of a large foundry at Harbin, Manchuria, which was operated under direction of the United States forces. Mr. Lee is taking a short vacation at his home in South Bend, Ind., prior to re-entering active foundry work in this country. He formerly was superintendent for the Studebaker Co., South Bend, the Gisholt Machine Co., Madison, Wis., and the South Bend Foundry Co., South Bend.

## Pittsburgh Foundrymen Visit Mesta Plant

More than 100 members of the Pittsburgh Foundrymen's association were the guests of the Mesta Machine Co., at its plant, Mesta, Pa., on the afternoon and evening of Jan. 19. The management provided guides to take the visitors through all departments, and transported them from Pittsburgh to the works and back in a special train. It also furnished a dinner, served in the company's dining rooms. The guests were impressed by the size of the castings in the steel foundry. The largest of these castings, one of which weighed more than 200,000 pounds in the rough and had a net weight of 175,000 pounds, are to form part of an armor plate press which is being built for the naval armor plate plant, Charleston, W. Va. The complete press will weigh 600 tons.

A. M. Fulton, president of the association, opened the monthly meet-

ing, held in the Mesta auditorium, and introduced Charles J. Mesta, who presided during the remainder of the meeting. Other speakers were Frank E. Mesta, Professor Tritsch and L. Iverson, all of the Mesta Machine Co. organization; J. S. McCormick, of the J. S. McCormick Co.; Henry Spilker, of the Sterritt-Thomas Foundry Co., William Yagle and S. D. Sleeth.

Frank E. Mesta briefly sketched the history of the company from its small beginning in Leechburg, Pa., in 1887, as a custom foundry under a partnership arrangement, to its present prominent position in the manufacture of heavy machinery. Mr. Mesta told of the subsequent incorporation of the business as the Leechburg Foundry & Machine Co., specializing in casting ingot molds and building light machinery; of the company's building of the first American tin plate plant following the passage of the McKinley tariff act; of the increase in capital stock to $200,000 in 1898, when 250 men were on the payroll, and of the other steps which resulted in the upbuilding of the Mesta industry. At present the company employs more than 2000 men and melts 10,000 tons of steel per month.

## New York Brass Foundrymen Elect Officers

The Metropolitan Brass Founders' association, at its annual meeting in New York re-elected its officers for the ensuing year. These are as follows: President and chairman, Frederick H. Landolt, proprietor of the Penn Brass & Bronze Works, Brooklyn, N. Y.; secretary and treasurer, William H. Paulson, Thomas H. Paulson & Son; executive board, E. O. Marshall, R. Hamilton & Sons; D. A. Vander Werken, Tiffany Studios, and Thomas H. Williams, E. A. Williams & Sons. During the past year the association has shown a healthy growth. It has undertaken to impress upon the trade in the metropolitan district the benefits resulting from the association's work.

## Malleable Association Elects Officers

Policies for the coming year were discussed at the annual meeting of the American Malleable Castings association held in Cleveland, Jan. 14. In the election of officers John A. Penton, Penton Publishing Co., Cleveland, was chosen as president. Robert E. Belt, who had been assistant secretary, was advanced to the position of secretary-treasurer. Mr. Belt will continue in charge of the Cleveland office of the association. E. E. Walker, Erie Malleable Iron Co., Erie, Pa., was elected vice president representing the western section, and Frank J. Eppele, Trenton Malleable Iron Co., Trenton, N. J., was chosen to represent the members in the eastern section. The research work of the association will be in charge of John C. Haswell, Dayton Malleable Iron Co., Dayton, O., who has been made chairman of the research committee.

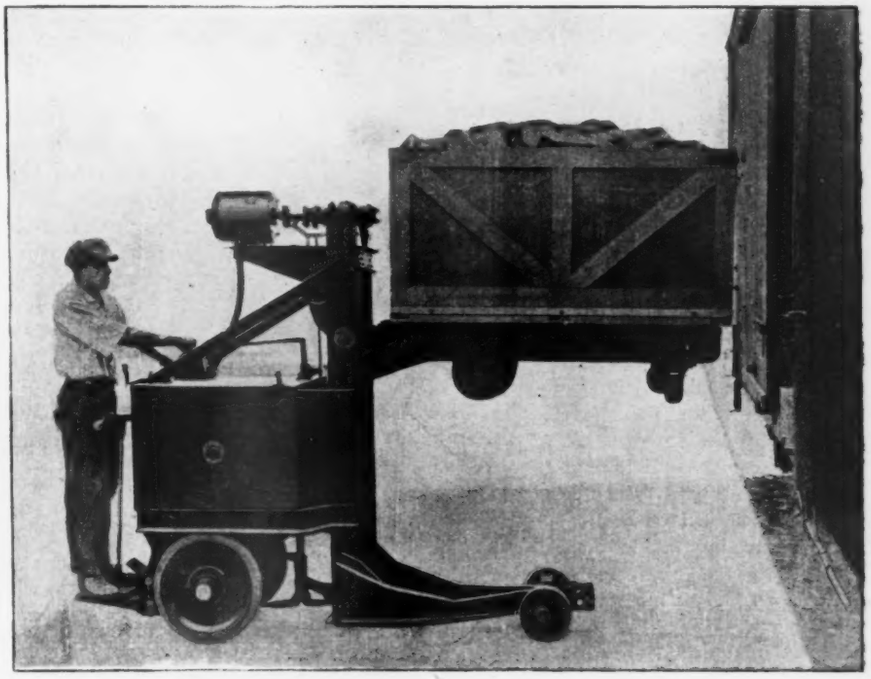
## French Foundrymen Study Cost Problems

A meeting of the French Foundrymen's association, known as the Syndicat Generale des Fonders en Fer de France, was held recently, at which the subject of foundry costs was discussed.

The discussion turned particularly on the different methods of apportioning overhead expense. It was generally agreed this is one of the most delicate points in foundry cost accounting. The consensus of the meeting seemed to be that the most satisfactory results would be realized by apportioning overhead expenses according to molding wages. It probably was realized by some of those present that in cases where castings are sold by weight this method throws a heavy burden on the more intricate jobs, unless allowances are made for the disproportionate amount of molding labor required on complicated castings.

## Combination Lifting and Carrying Truck

An industrial truck which with its own power elevates a 2-ton load to a maximum height of 76 inches and thus makes it possible to put material in box cars, stock rooms or trucks without rehandling, has been developed by the Lakewood Engineering Co., Cleveland. It is claimed that the storage capacity of a given floor space is greatly increased by this high lifting feature. A new method of storing which permits the selection of loads from specially designed racks is made possible with this type of truck.



THIS TYPE OF ELECTRIC TRUCK CONVEYS THE LOAD AND ALSO LIFTS IT INTO POSITION FOR SHIPPING OR STORING

The truck steers through all four wheels. This permits turning in a circle having a 92-inch radius and assures easy manipulation in narrow aisles, or congested parts of the plant. If necessary, the truck may be used inside a box car.

The truck is provided with three speeds forward and three reverse, directed through a conveniently located controller handle. The lifting mechanism is operated by a specially designed controller with one speed. The lifting is effected through high-efficiency steel worm screws. An individual motor is provided for raising the load.

The load platform is carried by a

cantilever type support and the load is balanced over the load carrying wheels. Ball bearings are used throughout, and by a special design of the company it is claimed that losses due to friction in elevating and lowering the load platform are greatly lessened.

## Electric Furnace Design Is Changed

A new design of their rocking-type electric furnace has been developed by the Industrial Electric Furnace Co., Chicago. The bottom is a heavy-ribbed steel casting, and no electrical or water connections are underneath. The roof is fastened to the roof-opening frame in such a manner that it can be easily removed when necessary to change roofs. All that is required is to pull out the connecting pins and draw back the roof-opening frame work into the charging position. The roof may then be lifted off by the crane which serves the furnace and a new roof set in place.

A rear view of the furnace in a melting position is shown in the figure to the right in the accompanying illustration. From this it may be seen that all the machinery for opening the roof and for tilting the furnace is combined in one system below the floor level and back of the furnace. All operating equipment is mounted on a heavy structural-steel frame. Electrical connections and connecting cables are underneath the platform of the furnace. The motors for operating the electrodes may be seen mounted on the rear.

ELECTRIC 25-POUND LEAD AND BABBIT MELTER

The pouring position is shown in the center. The electrode supports have a traveling range equal to the distance from the bath to the roof so that an entire heat of the most bulky scrap can be melted without adjusting the electrodes. When the furnace has the cover removed, as shown in the figure to the left of the accompanying illustration, it is possible to charge the scrap through the opening with a crane. This allows the furnace to be completely filled before starting to melt. An other advantage of this method of charging is that a charge of preheated scrap may be added quickly to the furnace. Preheating the charge is advocated by the electric furnace company as being economical. Metal charged at a red heat can be melted with a lower electric power consumption than if it were charged cold.

The furnace is built in 2, 4 and 7-ton capacities. It can be obtained in either the 2 or the 3-phase type and with either an acid or a basic lining. Two electrodes are used on all sizes which are made with oval baths so that the arcs will not be too close to the walls of the furnace.

## Electric Melting Pot

A new electrically operated melting device for lead, babbit and similar metals recently has been developed by the General Electric Co., Schenectady, N. Y. It is said that it will eliminate the loss of time and material, and also the risks of losses by fire, accidents, etc., which attend the melting of metals in haphazard containers. This new pot is durably constructed and is provided with four legs on the bottom and a flange on the top. It may be set on a table or the floor without fear of upsetting or it may be lowered into a hole so as to be flush with the top of the table. It is fitted with a plug and socket fixture that can be attached to any electric light circuit.

The heating feature is a coil, wound

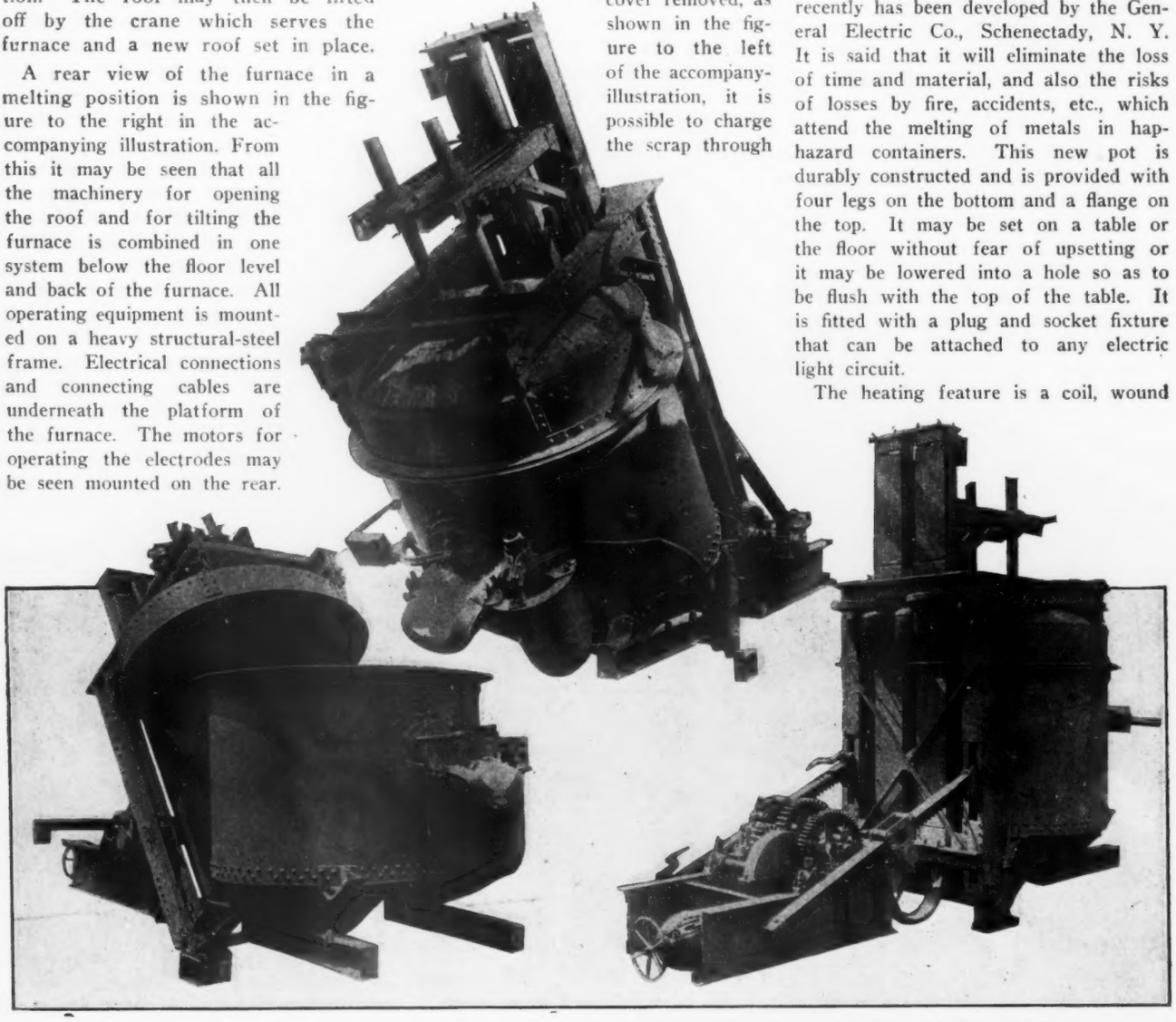
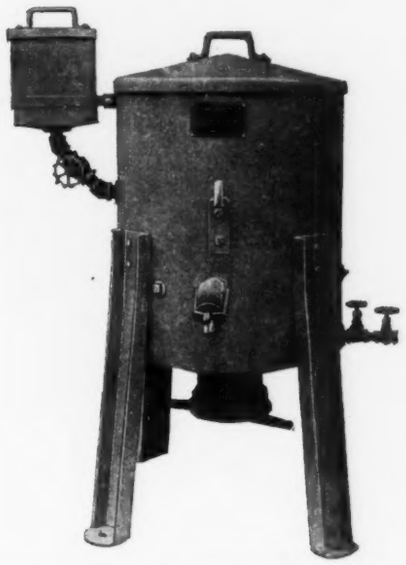


FIG. 1—ROOF TILTED BACK TO PERMIT CHARGING OF FURNACE FIG. 2—ROOF-OPENING FRAME IS LOCKED TO FURNACE AND ENTIRE UNIT IS TILTED TO POURING POSITION FIG. 3—FURNACE IN MELTING POSITION SHOWING ELECTRODE MOTORS AND FURNACE TILTING MECHANISM

around the container from top to bottom and thoroughly insulated from the outside, thus insuring an even distribution of heat through the contents of the pot, and preventing temperature loss due to radiation. The automatic regulation which is the principal feature of the device has been obtained by using a wire which has a positive temperature coefficient. That is to say, when the temperature of the heating rises, its resistance rises proportionally, thus limiting the current, and consequently, the heat.



SELF-CONTAINED BLACKING MIXER OPERATED BY COMPRESSED AIR

When cold metal is put into the container the initial rise of current is enough to melt it quickly. After it is melted the current is automatically reduced to just enough to keep it molten, but not enough to burn it. This does away with the thick scum of oxidized metal around the top. This feature permits the operator to leave the pot to itself when necessary without fear of wasting good metal through too much heat, or setting something on fire.

## Home Made Cupola Meets Requirements

(*Concluded from page* 114)

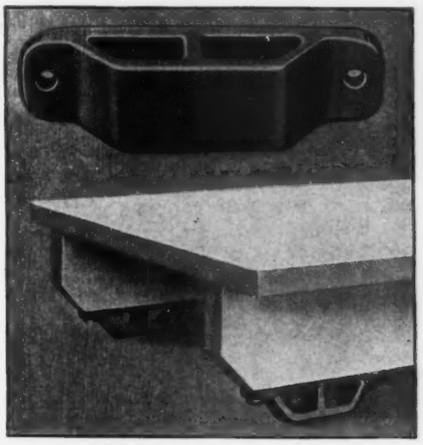
As may be seen in the illustration the stack of this cupola is formed of two oil drums without heads and stacked one upon the other. It is lined with fire brick to an interior diameter of 23 inches. The blast is supplied by a small fan driven by a ¼-horsepower motor. When first set up the stack rested on a temporary foundation but eventually was provided with a suitable cast iron base and legs.

## Feet Prevent Skid Wear

Cast iron feet have been designed by the Cowan Truck Co., Holyoke, Mass., to reduce the wear on the runners of wooden platforms or skids used in connection with elevating trucks. The most common type of platform is of wood and the runners wear so rapidly that in a short time the height of the platform is reduced so that the arms of the trucks will not run under it. The metal feet are bolted to the skids as shown in the accompanying illustration.

## Blacking Mixed by Air

The pneumatic blacking mixer shown in the accompanying illustration has been developed quickly and thoroughly to mix wet blacking for foundry use. The water, blacking and binding material are assembled in the tank and then a jet of air is introduced at the bottom. This produces a violent agitation and as a result it is said the contents of the tank are uniformly and satisfactorily mixed. The blacking may be taken away in individual buckets from the nozzle or one or more lengths of hose and sprayers can be attached to the tank and the blacking sprayed directly on the mold or cores. The machine is substantially constructed. It is supported on four channel iron legs and a small tank for holding the binding material is attached high up on one side. An air and water valve near the bottom on the opposite side and a large valve in the bottom furnish a ready means for cleaning the tank when necessary. The mixer is built in two sizes, 50 and 30 gallons capacity and is supplied by J. S. McCormick Co., Pittsburgh.



THE CAST IRON FEET ARE BOLTED ON THE FEET OF THE SKIDS

The name of the Aluminum Castings Co. has been changed to Aluminum Manufacturers, Inc. The company, which has its head offices in Cleveland, operates plants at Cleveland, Detroit, Buffalo, Fairfield, Conn., and Garwood, N. J.

# What the Foundries Are Doing

## Activities of the Iron, Steel and Brass Shops

Williams, White & Co., Moline, Ill., contemplate the erection of a new foundry, 150 x 325 feet.

The Cincinnati Steel Castings Co. recently increased its capital stock from $50,000 to $100,000.

The plant of the Comstock-Castle Stove Co., Quincy, Ill., recently was damaged by fire.

Fire recently damaged the plant of the Davis Foundry Co., New Castle, Ind.

A permit has been taken out by the Strong Steel Foundry Co., Buffalo, to erect a new foundry building.

An increase in its capital stock from $300,000 to $400,000, recently was made by the United States Switch Co., Eau Clair, Wis., which conducts a foundry and machine shop. The increase will be used in enlarging the output of automatic railroad devices.

The Southern Foundry & Mfg. Co., Owensboro, Ky., will make improvements to its plant.

The plant of the Birmingham Machine & Foundry Co., Birmingham, Ala., recently was damaged by fire.

Fire recently damaged the plant of the Grand Haven Brass Foundry, Grand Haven, Mich.

The McNaul Boiler Co., Toledo, O., has leased to the Detroit Stoker Co., the foundry on Water street.

The Erlez Stove Mfg. Co., Erie, Pa., has taken out a permit to make alterations to its plant.

The Wise-McClung Mfg. Co., New Philadelphia, O., has increased its capital to $7,000,000, in order to finance the enlarging of its plant. The additions will include a 2-story building for assembling and storage of small parts, and an enlarged machining and drilling building, steam heating and power plant, and the erection of an addition to the foundry.

A site on which to erect a modern plant has been purchased by the American Range Foundry Co., St. Louis. C. W. Nye is president.

The Baltimore Car Foundry Co., Curtis avenue and Beech street, Baltimore, plans the erection of an addition to its plant, 90 x 100 feet.

The Hammond Malleable Iron Co., Hammond, Ind., has been incorporated with a capital of $10,000, by H. J. Wanner, H. C. Wanner and B. J. Steelman.

Capitalized at $35,000, the Jewell Brass Co., Cleveland, recently was incorporated by Sidney N.

Weitz, Engineers building, M. J. Grossman and others.

The capital stock of the Buckeye Casting Co., Lima, O., recently was increased from $10,000 to $25,000.

The capital stock of the Hercules Gas Engine Co., Evansville, Ind., recently was increased from $250,000 to $500,000.

Fire recently damaged the plant of the Crucible Steel Castings Co., Champlain avenue, Cleveland, but production was held up only 24 hours.

The building occupied by the K-T Foundry Co., North Water street, Galt, Ont., recently was damaged by fire. The plant will be rebuilt.

The main building at the plant of the Welland Iron & Brass Works, Welland, Ont., recently was damaged by fire. It will be rebuilt.

The Charles Jurack Pattern Works, 199 Cregon street, Milwaukee, recently increased its capital from $50,000 to $150,000.

The Sailor-Whitmore Co., Neenah, Wis., has broken ground for the erection of an addition to its gray iron foundry and machine shop.

Plans are being prepared for the erection of an addition to the plant of the Valley Foundry Co., East Hampton, Conn.

The American Car & Foundry Co., Milton, Pa., recently announced plans for additions which when completed will double the capacity of its plant.

The Johnson City Foundry & Machine Co., Johnson City, Tenn., G. W. Swetzer, president, recently increased its capital from $10,000 to $100,000.

The Ohio Malleable Iron Co., 1343 Fields avenue, Columbus, O., recently obtained a permit for the erection of an addition to its plant.

The Northwestern Pattern & Machine Co., Toledo, O., recently was incorporated with a capital of $10,000, by J. P. Miller, H. P. Whitney and others.

The Automotive Tractor Co., Frederick, Md., plans to erect a machine shop and foundry, 50 x 200 feet.

Heggem & Davis, 624 Kennedy building, Tulsa, Okla., will erect a foundry and machine shop, 90 x 100 feet.

Plans have been prepared for the erection of an addition to the plant of the Atlas Foundry Co., Milwaukee. The building will be 80 x 80 feet.

Capitalized at $100,000, the Cuyahoga Foundry Co., Cleveland, recently was incorporated by E. Knapp, V. Foukal and others.

The Aluminum Manufacturers, Inc., Garwood, N. J., manufacturer of aluminum, brass and bronze castings, plans improvements to its plant.

The Bronze Die Casting Co., Pittsburgh, has been incorporated with $10,000 capital, by J. Sidney and James H. Hammond, 624 Clyde street, and Edward A. Pitcairn, 5431 Fifth avenue, Pittsburgh.

The Wagner Castings Co., Decatur, Ill., is said to have purchased the plant of the Decatur Foundry Co., which it has occupied since its organization, and is reported planning the erection of additions.

George H. B. Martin and John A. MacPeak recently were named as the incorporators of the Vineland Foundry & Mfg. Co., incorporated at Camden, N. J., with $50,000 capital.

Plans are being prepared by the Slinger Foundry & Machine Co., Portage, Wis., for the erection of an addition to its plant, to double the capacity of its molding floor.

The Oregon Brass Works, Portland, Oreg., has awarded a contract to the Detroit Electric Steel Furnace Co., for furnishing and installing two electric furnaces.

Contracts for rebuilding the plant of the Portland Stove Works, Portland, Oreg., which was recently damaged by fire, have been awarded to S. Synnes, 33 Winchell street, Portland.

Contracts have been awarded for the erection of an addition to the plant of the Wilson Stove & Mfg. Co., Metropolis, Ill. The extension will double the capacity of the plant.

The Faison Co., Inc., Greensboro, N. C., recently was incorporated with $50,000 capital to engage in the manufacture of iron and steel castings, by Ralph R. and Preston Faison and others.

The Southern Wisconsin Foundry Co., Madison, Wis., has broken ground for the erection of an addition to its gray iron shop, 30 x 210 feet. H. Frindorff is the general contractor.

Fire recently damaged the plant of the Harrisburg Pattern & Model Co., Harrisburg, Pa.

P. W. Mulder and others recently organized the Imlay City Foundry Co., Imlay City, Mich., with $25,000 capital.

The Carlisle Foundry Co., Carlisle, Pa., has been organized by C. S. Brinton, Thomas McDonald and others, and will build an addition to its plant.

Fuller & Sons Mfg. Co., Kalamazoo, Mich., plans alterations to its main building and foundry. P. R. Ramp is in charge.

Dowitz & Webb, architects, 232 St. Paul street, Baltimore, are preparing plans for the erection of a foundry and machine shop, 60 x 300 feet. The name of the owner has been withheld.

The Manufacturers' Foundry Co., Fifteenth and Oklahoma avenues, Milwaukee, contemplates important enlargements to its gray iron and malleable shop during the year.

Plans have not been completed for rebuilding the plant of the Kenny Foundry, Mansfield, O., which was recently damaged by fire. H. D. Kenny is manager.

The Griffith Foundry Co., Griffith, Ind., recently was incorporated with $50,000 capital, to manufacture iron products. The incorporators are H. C. Stuart, C. F. Holt and S. E. Stuart.

Capitalized at $30,000, the Page Foundry Corp., Brooklyn, N. Y., recently was incorporated by M. Klein, H. E. Diamond and A. Werner, 52 West 119th street.

The Henry Miller Foundry Co., Cleveland, according to a report, will establish a plant at Guelph, Ont., and has acquired a building recently vacated by the Sherer-Gillett Co.

The Regle Brass Co., Greenville, Mich., recently incorporated with $100,000 capital, will erect a plant, 60 x 200 feet. J. B. Couture is president and general manager.

The J. C. Green Foundry Co., Vassar, Mich., has purchased a site of seven acres on which it plans the erection of a foundry, 60 x 160 feet. J. C. Green is president.

The C. & G. Pattern Works, Indianapolis, recently was incorporated with $10,000 capital, to engage in the manufacture of iron patterns, by F. D. Crider, Charles J. Gisler and A. H. Gisler.

The F. Rassmann Mfg. Co., Beaver Dam, Wis., maker of steel barn equipment, is installing a new cupola and making other improvements to its foundry and machine shop, to effect an increase of about 50 per cent in output.

Capitalized at $10,000, the Hartford Foundry Co., Hartford, Wis., recently was incorporated by Robert La Point, Samuel S. Powers and I. L. Bonniwell, to take over the business of the La Pointe Foundry Co. Additions will be built.

The Clarage Fan Co., Kalamazoo, Mich., plans a $100,000 building program, which provides for doubling its foundry department, installation of second cupola and enlargements to core room and pattern shop. Charles Clarage is head of the company.

The capital stock of the Wausau Iron Works, Wausau, Wis., has been increased from $50,000 to $100,000, to handle increasing business and to provide for the enlargement of its structural fabricating shop, foundry and machine shop.

Articles of incorporation have been filed by the Lake Erie Foundry Co., Painesville, O., and it has leased a portion of a building here, which will be equipped for the manufacture of small gray iron castings. L. H. DeForest is manager.

The General American Tank Car Co., Chicago, is preparing to build a plant on the Mississippi river near New Orleans, which will include a large steel foundry and machine shop. Tank cars, gondolas and other types will be built.

The Henry Miller Foundry Co. recently sold its Canton, O., plant to the Motor Casting Co., a new corporation which was organized by H. H. Timken, J. G. Obermeier, Charles Balough, Gordon M. Mather and R. W. Gallagher.

The Superior Brass Foundry Co., Milwaukee, which was recently incorporated with $50,000 capital, by Philip Loeher, Frank Scheder and H. H. Wheeler, has taken over a shop building at 282 Lapham street, and is converting it into a brass and bronze casting shop.

Contractors have started the erection of a foundry, 140 x 160 feet, for the Buda Motor Co., Harvey, Ill.

An oil explosion recently damaged the plant of the Record Foundry & Machine Co., Moncton, N. B.

The Crane Co., Chicago, according to a current report, plans to erect a foundry at Birmingham, Ala.

Capitalized at $50,000, the Champion Foundry Co., Piqua, O., recently was incorporated by J. E. Bryan, Charles L. Hinsch, C. F. Stickler, L. A. Frazier and Maurice Wolfe.

Work will start shortly on the erection of an addition to the foundry of the American Skein & Foundry Co., Racine, Wis. The extension will be 100 x 240 feet. The general contractor, Nelson & Co., has let the contract for the structural steel to the Worden-Allen Co., Milwaukee.

The Rath Foundry & Machine Co., Sebring, O., recently was incorporated with $50,000, by Charles J. Rath, Charles M. Wilson and others. The company is planning to build an addition to the Scofield building in Sebring, and will engage in the manufacture of general metal castings.

The Ilg Electric Ventilating Co., Chicago, is erecting a plant which will have a floor space of 48,000 square feet. The building is the first of a number to be erected within the near future. Practically all equipment for the plant has been contracted, with the exception of an electric traveling crane and a monorail system.

A new brass foundry at Worcester, Mass., has been organized under the name of the Vulcan Foundry Co., 35 Hermon street, with a capital of $10,000. The company will specialize in the manufacture of high grade bronze castings for hydraulic purposes. Later a cupola for melting iron will be installed. The incorporators are Robert J. Molt, Samuel Seder and G. W. Wood.

The Joseph McGee Iron & Brass Foundry Co. and the Russell Foundry & Machine Works, both of New York, have consolidated and in the future will be known as the McGee-Russell Founders & Machinists Co. The new company is capitalized at $60,000, and was incorporated by E. and J. M. Russell and M. M. Storm, 323 East Twenty-fifth street, Brooklyn, N. Y.

The Fahnestock Mfg. Co., Avonmore, Pa., is asking for bids on the erection of an addition to its main steel foundry building. The addition will be 130 x 140 feet, equipped with cranes in three spans. Complete plans include the installation of open-hearth furnaces, molding machines and other equipment, which will double the present capacity of the plant. So far contracts have been let for additional air compressors and pneumatic equipment.

The principal owners of two large affiliated foundry companies at West Allis, Milwaukee, have organized a new corporation styled the G. & M. Machine Co., with an initial capital of $7500, to conduct a machine shop business. George P. Gerlinger and A. C. Menningen are the incorporators. George P. Gerlinger is president of the Gerlinger Steel Castings Co. and William E. Gerlinger is president of the Gerlinger Electric Steel Foundry Co.

Incorporated under the laws of Rhode Island, the Westerly Brass Co., Westerly, R. I., now is making extensive changes and additions to its plant. It recently has contracted for a new line of work, which calls for the installation of air compressors with the necessary electrical equipment. A battery of molding machines is being installed, and one plant addition is now under construction, while erection of another will be started in the spring.

The J. I. Case Plow Works Co., Racine, Wis., a $10,000,000 corporation organized recently to effect a consolidation of the J. I. Case Plow Works and the Wallis Tractor Co., is entering upon a large foundry construction project involving an expenditure of $500,000. Four and one-half acres have been purchased as a site on which to erect a gray iron shop, 130 x 375 feet, and a malleable foundry, 150 x 300 feet. Later a machine shop and assembling group, with warehouses, shipping rooms, etc., will be erected on the site.